

**MANAGING EXTENSION OF TIME (EOT) CLAIMS IN  
BUILDING PROJECTS IN SRI LANKA**

Janak Kolitha Jayawardana Dasanayaka

(159156B)

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Department of Building Economics

University of Moratuwa

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## **Declaration**

I declare that this is my work and this dissertation does not incorporate without acknowledgment any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

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## **Abstract**

### **Managing EOT Claims in Building Projects in Sri Lanka**

Compare to other industries, more claims are arising in the construction industry, and a majority among those are EOT claims. Key reasons for arising claims are the involvement of many parties, temporary setup of the organization, long period for delivery, unforeseen events, changes in market conditions, and change of government requirements. Mostly claims lead to arise disputes, ending with adjudication, arbitration, litigation and loss both time and money. For avoiding or minimizing EOT claims, it is necessary to identify the most significant causes of EOT claims, remedies, relevant parties, and occurring effects.

Recognized six lists related to EOT claim as; owner related causes, consultant related causes, other related causes, owner related remedies, consultant related remedies, and effects to conducted research. The questionnaire tested via a pilot survey and carried out a questionnaire survey with three Delphi rounds. Results confirmed through expert validation. Forty-one industry experts were involved in the process. A binomial test was used to derive the existence factors, and the RII equation was used to obtain significant levels for each factor.

Most significant; owners related cause was “Unrealistically short project duration,” and for consultants related was “Incomplete Contract Document,” and for other related category it was “Changes in statutory requirements.” Consequence comparing all three categories together, the most significant cause was found as “Incomplete Contract Document.” From the 22 remedies, “Choose experienced consultant” was the first rank of owner related remedies, similarly “On-time approval of drawings” was attributable to the consultant. In the overall comparison, both owners and consultants’ categories, the most appropriate remedy was “On-time approval of drawings.” The most arising effects of EOT was “Time overrun.”

These findings are equally essential for Owners, Consultants, and Project Management (PM) strategy developers.

**Keywords:** *EOT claims, Causes, Remedies, Effects, Owners, Consultants, PM*

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## **Dedication**

To my Wife and Daughter

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## **LIST OF ABBREVIATIONS**

PM	–	Project Management
M.Sc.	–	Master of Science
UAE	–	United Arab Emirates
UK	–	United Kingdom
USA	–	United States of America
EOT	–	Extension of Time
LD	–	Liquidated Damages
TMP	–	Temporary multi-organization
R1	–	Round one
R2	–	Round two
R3	–	Round three
RII	–	Relative importance index
ADR	–	Alternative Dispute Resolution

# **CHAPTER 1: Introduction to Research**

## **1.1 Background**

Claims arise from as in almost every construction project. Construction projects in Sri Lanka today have more claims than they had previously. One of the most significant types of claims is the 'Extension of Time (EOT) claims.' Construction projects comprising many parties, including; owners, consultants, contractors, subcontractors, suppliers, and government. Different conditions (by internal or external forces) increase every day and effect on start, middle or at the end of the projects, therein that impact to delaying the projects and number of EOT claims also increasing day by day (Fullerton, 2015). According to Tochaiwat and Chovichien (2004), the high competition influence contractors to bid projects with minimum profits and overhead margin to be in the industry. Tochaiwat and Chovichien (2004) further state multiparty involvement, a trend of arriving more complex projects, increasing the level of risk, major changes made by parties, the legal approach adopted by owners and the contractors have had an impact on the continuous increase in the number of claims in the construction industry.

Claims generally mean losses and no winners occur to parties. Different types of costs apply to different parties here. The innocent party can contractually bear the costs and certain instances, including profit, but this rarely true/ happens (Fullerton, 2015). Sometimes, this loss (the applicable liquidated damage (LD) amount and claim related other cost) is attempted to incorporate into contractors offers. This trend influences price increases in the building sector and prevents developers from investing in the projects, and the whole construction industry may slow down as a result of this. On the other hand, when an EOT claim is submitted and if that claim is not settled, then that will cause to arise a dispute. Unless these controversies are resolved by the parties, they must follow the Alternative Dispute Resolution (ADR) methods, and in the event of further failure, the parties may be required to resort to litigation. The litigation means there are no winners except lawyers (Fullerton, 2015).

Currently above said claim situations are influencing to have more time overrun, cost overrun or both losses to both contractors and owner (“www.law teacher.com, 2018”). In the current construction industry, a great amount of conflicts occurs, and those are well known, regrettably, the most significant causes and factual loss related to conflict are not well understood. Consequently avoiding claims, conflict, or disputes from the construction projects requires a thorough understanding of the root causes of contractual claims and grounds of claims (Semple, Hartman & Jergeas, 1994). The huge growth of construction claims provides the alarm for the establishment of an effective strategy for construction claim management (Bakhary, Adnan & Ibrahim, 2015).

## **1.2 Research Gap & Problem Statement**

Reviewed to several recent research, found, types of claims such as; Humphreys (2016) explained four (4) main categories, and under that, nine (9) types and (Zaneldin, 2006) explained five (5) types.

Previous researches discussed about causes of claims and some of the recent research were; Shah, Bhatt and Bhavsar, 2014 forty-five (45) causes have been discussed, Bakhary et al. (2015) sixteen (16) causes have been discussed, Zaneldin (2005) twenty-six (26) causes have been discussed.

Al-Khalil and Al-Ghafly (1999), “determined the most important causes of delay claims in public utility projects in Saudi Arabia based on the frequency and severity of these causes. Chester and Hendrickson (2005), presented a case study of a project with seven different construction claims in the United Arab Emirates for causes, severity, and frequency. Scott (1997) conducted a survey to investigate and develop mechanisms for preparing of delay claims and evaluate delay claims in the United Kingdom.

Similarly, some recent research such as Assbeihat (2016), Marzouk and El-Rasas (2014), Alinaitwe, Apolot and Tindiwensi (2013), Dolage and Rathnamali (2013),

Jeyakanthan and Jayawardane (2012), Mahamid, Bruland & Dmaidid (2011) and Pourrostam and Ismail (2012) have also well explained the reasons for delays.

Previous research thus identifies types of claims, associated claims causes, causes of delays, preparations for a comprehensive EOT claims, and how the EOT claims should be assessed.

However, there is no specific research which analyzed all EOT related causes, remedies, and effects with responsible parties in one research. To manage the EOT claims, gathering information from several researches can create errors in the data due to differences in locations, time periods, and method of research techniques.

Previous researches do not make available significant levels for remedies. Since they have not provided significant levels for remedies, addressing all remedies at once is therefore not practical. Consequently, manage the EOT claims, the applications of remedies make priority wise by selecting the most significant remedies. If failing, to act in such a manner, continue to arising EOT claims.

Available researches do not provide the overall significant levels by providing ranks among owner, consultant, and other related causes. Considered to available remedies also not provide overall significant levels between owner and consultant. Therefore lacking most significant causes/remedies with the relevant party makes it impractical for addressing or application of them.

Currently, the availability of data in the industry is not best suited to manage the EOT claims in a more strategic manner. The key obstruction was that even there were some numbers of causes of EOT claims found with the significant level it has to be validated for the current condition of the industry, to location and specific area. The focus of this research is building projects in Sri Lanka.

Since the key causes were not addressed and related significant remedies were not implemented, EOT claims continue to rise in the construction industry. Consequently,



a priority wise preventive actions were still needed to begin by addressing the major causes or applying most suitable remedies with the knowledge of the effects of EOT claims.

### **1.3 Aim**

This research aims to provide recommendations for managing Extension of Time (EOT) claims in building construction projects in Sri Lanka.

### **1.4 Objectives**

1. Identify the causes and effects of EOT claims and parties responsible for the causes.
2. Identify remedies available for the minimizing of EOT claims and the relevant parties.
3. Investigate causes, and effects of EOT claims, and applicable remedies in Sri Lankan building construction projects.

### **1.5 Scope and Limitations**

This research was carried out of the building construction projects in Sri Lanka. The research was based on three main categories, such as Owners, Consultants, and Others. Under the consultants included engineer to contract, design consultants, project managers, and cost consultants. Employers and developers were regarded as owners. Factors not related to owners and consultants were considered under the category of others such as; statutory changes by government, exceptional weather conditions, and market conditions, etc.

Questionnaire survey research for data collection was adopted with the Delphi technique. The industry experts selected having over ten years' experienced; senior quantity surveyors, senior project managers, senior architects, and senior engineers. Selection of expert's considered from the organizations; owners, consultants, and

contractors. The Pilot Survey further strengthened the questionnaire. Data collected through three Delphi rounds. The data (Delphi round two) were taken following a binomial test factor. Data analysis was performed through the Relative Importance Index (RII) equation. The results were verified by the process of expert's validation. The findings of this research were based on an analysis of the literature review and the views of opinions by the experts in the industry.

## **1.6 Chapter Summary**

The dissertation arrangement is as follows.

- Chapter One:** Chapter one presents the background, research gap & problem statement to the dissertation, aim, objectives, scope, and limitations.
- Chapter Two:** Chapter two presents the results of the literature review for the types of claims, reason for selection of EOT claims to this study, causes of EOT claims, remedies, the effect of EOT claims and the responsible party for the causes and relevant party for remedies.
- Chapter Three:** Chapter three presents the methodology of research with data collection technique, sample selection, the establishment of the questionnaire, data evaluation, and data analysis methods adopted for this study.
- Chapter Four:** Chapter four presents all three Delphi rounds of data collection results in statistically, data analysis and ranking, results discussion, comparison of results between previous rounds and top five ranks with previous researches.
- Chapter Five:** Chapter five presents the conclusions, recommendations, and recommendations for further study.

## **CHAPTER 2: Literature Review**

### **2.1 Introduction**

Managing of EOT claims that need to be understood; the difference between claims and construction claims, nature of the claims in the global construction industry and nature of claims in the Sri Lankan construction industry. It must also understand what types of claims are available in the construction industry and the applicable parties. Accordingly, this chapter initially identified various types of claims and then derived common types and explained each of them in detail. The most emerging type of claim in the construction industry was also identified as EOT claims among the different kinds of claims. Therefore, the in-depth literature analysis is undertaken through several previous literature works written for EOT claims. The causes, remedies, and impacts of EOT claims and relevant parties were likewise discussed in detail. Similarly, include six different lists as well (causes related to the owner, causes related to the consultant, other causes, remedies associated with the owner, consultant related remedies and effects) to carry out the research in Sri Lanka.

### **2.2 What is a claim**

A claim is defined in the English-Oxford dictionary as “Demand for something as due, an assertion of a right to something.”

The word “claim” originated from the old French word “claime” (Wood, 2006). The term claim shall be defined as “A request for something considered one’s due/property or a right or title to something.” In general, a claim is an application to compensate one of the parties involved in the contract for damages suffered by one of them. According to Semple et al. (1994), a claim presents the basis of the claim (causes and effects), explains the contractual and legal basis for pay merit (entitlement), and quantifies the resulting damages. The definition of claims varies from scholar to scholar, but their effect is equal worldwide. However, the significance will vary from country to country.

### 2.3 Claims in the construction industry

Dinku and Kahssay (2013), define claims in the construction industry as demands for compensation in terms of money or time extension or combination of both that a party rightly or erroneously believes the party is entitled. The more basic definition is a request for compensation for damages incurred by any party to a contract (Semple et al., 1994). According to the Fidic (2017) “Claim means a request or assertion by one party to the other party for an entitlement or relief under any Clause of these Conditions or otherwise in connection with, or arising out of, the Contract or the execution of the Work.” Claims are common in the construction industry, and it occurs for several reasons such as; delaying a project, delay effect on claims for extra costs and delay leads to extensions of time (Gulezian & Samelian, 2003) and (Koushki, Al-Rashid & Kartam, 2005).

The construction claims result in a claimant's assertion of an obvious right to demand extra costs or time, or both (Chappell, 2011). According to Tochaiwat and Chovichien (2004), construction claim is a demand/assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of contract terms, payment of money, an extension of time or other relief with respect to the terms of the contract. Chan and Kumaraswamy (1997) state the relationship between “conflicts,” “claim” and “dispute”. This relationship shows in Figure 2.1.

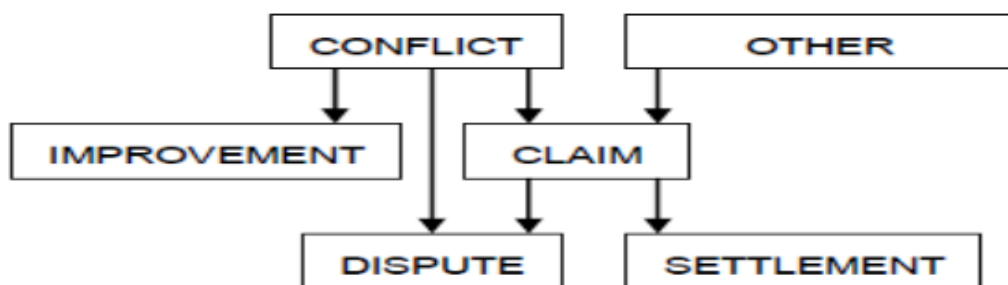


Figure 2.1: Relationships between “conflict,” “claim” and “dispute”  
(Source: Tochaiwat, & Chovichien. 2004)

Tochaiwat and Chovichien (2004), explain disputes arising from long-term disagreements on unsolved claims and delayed or critical conflicts. Where a claim exists, the client and the contracting party can agree on the claim and thus make a change order or an alteration or can disagree and establish a contractual dispute. When claims turned to dispute, then that has to be resolved throughout the negotiation, mediation, arbitration, and litigation process (Ren, Anumba & Ugwu, 2003). Analyzing to various causes of claims, understood those were adversely affected a project's delay. Therefore, it is a major task to resolve it as and when arises cause (Alkass, Mazerolle & Harris, 1996). Likewise determining the impact, timing and effect of each and every cause to the overall delay assist the parties to settle the claim without litigation (Vidogah & Ndekugri, 1997).

Taking into account the Sri Lankan construction industry, claims and disputes usually arise in the procurement of supplies and services contract and the installation of equipment contract. Most disputes were resolved within the site in the early days of construction. They settled to take place through informal meetings between the parties of the client, contractor, and engineer to contract. However, construction disputes in nowadays are stronger and more complex rather than ordinary civil-cases in Sri Lanka. Claims and disputes will, therefore, first be tried to resolve with negotiation and if they fail, then refer to the adjudication and arbitration (Abenayake & Weddikara, 2013).

Abenayake and Weddikara (2013) acknowledged that there are key reasons for disputes in the Sri Lankan construction industry; breaches of contract by the parties of the contract, contain errors in drawings and specifications, inappropriate execution/administration of the responsibilities by the parties of client or contractor or subcontractor, ambiguities, omissions, unexpected tax, and price fluctuation.

#### **2.4 Type of claims in the construction industry**

Researches and studies done by several authors in different countries have found various types of claims, and Figure 2.2 illustrates those types of claims. Likewise, Figure 2.2 shows the sequence of arising EOT claims.

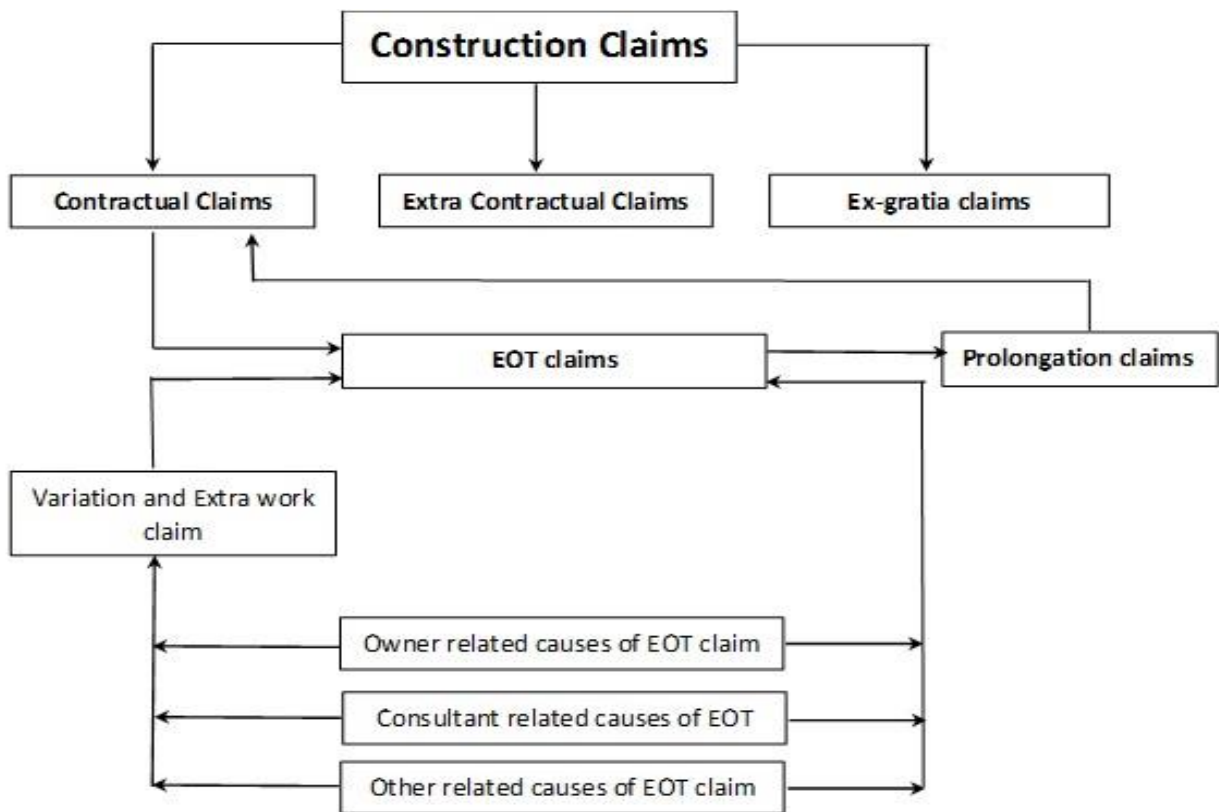


Figure 2.2 – Types of claims in the construction industry

Adopted from: (Zaneldin, 2006), (Chappell, 1984), (Alkass et al.,1996), (Hughes and Barber, 1992), (Humphreys, 2016), Williams (2003)

### 2.4.1 Contractual claims

Arise out of the express provision of the contract, for an extra cost, expense, and direct loss specifically provided as a remedy in the contract for breach of contract (Zaneldin, 2006). Contractual claims fall within the specific clauses of the contract, typically ground conditions, valuation, variations, late issue of information, and delay in inspecting finished work (Chappell, 1984), (Alkass & Harris, 1991) and Hughes & Barber, (1992). Accordingly, the EOT claim arising within clauses mentioned in the subsequent contract such as; variation, instruction delays by consultant, approval delays, and adverse weather condition, etc. Therefore, it is also a type of contractual claim.

#### **2.4.2 Extension of Time Claims (EOT)**

The EOT claims are the most common claims in the construction industry, as they are met by each contractor in almost all construction projects. Usually, the parties agree on a completion date and incorporated that in their contract. However, the contractor should complete defined work in a reasonable time, unless the date of completion is not mentioned. Every standard form of contracts (e.g., FIDIC, ICTAD or JCT) usually allow an adjustment of the completion date and will enable a time extension for the contractor. However, the contractor should prove what causes the delay, and whose fault it was (Humphreys, 2016).

The claims could be created either by a party to the contract (Owner and Contractor) or non-contracting party (third party damages, e.g., damage to adjoining property) or outside forces (Others). If projects are delivered after their due dates due to own delays caused by the contractor (culpable delay), EOT claim does not arise but leads to a liquidated damage (LD) claim, which is the genuine loss for the owner where the contractor is responsible (Zaneldin, 2006). According to Williams (2003), If the delay is arisen by the Employer and if the contractor suffers delay and/incurs a cost as a result of the Employer's failure, then the contractor is entitled to an extension of time and cost plus overhead and reasonable profit.

Construction delays denote to the time overrun with cost or without cost beyond the completion date specified in a contract or latter parties agreed date for delivery of a project (Assaf & Al-Hejji, 2006). Bramble and Callahan (2011) explain delay is classified into two major categories such as; excusable and non-excusable. In addition, excusable delays may have been categorized as compensable as well as non-compensable.

The contractor cannot, therefore, claim time extensions and additional compensation because of the contractor's fault (Bramble & Callahan, 2011) and (Yates & Epstein, 2006). When compensable delays caused by the client or their representatives without involving the contractor otherwise their subcontractors, the contractor is entitled to an

EOT claim (Bramble & Callahan, 2011) and (Yates & Epstein, 2006). Excusable non compensable delays may arise due to the ‘Acts of God’ like exceptional weather conditions which are beyond the control of the parties to contract by the owners or contractors. These delays are not the responsibility by the owner, consultant, or contractor and therefore entitling contractor to have EOT, but not to additional costs (Yates & Epstein, 2006).

### **2.4.3 Prolongation claims**

Prolongation claim is arising for the recovery of the actual loss that the contractor incurs because of the employer’s delay event, which causes that the contractor unable to complete the works by the contractual date for completion, but has been obliged to complete later, i.e., the contract period has been prolonged (Chappell, Powell-Smith & Sims, 2008). However, the contractor has to prove EOT entitlement before the submission of the prolongation claim. The evidence that entitles for EOT is almost similar to the evidence required to claim for prolongation claim. Anyhow, separate exercise is required for the quantification of losses (Hughes, Champion & Murdoch, 2015). EOT claims are not always arising prolongation claims it has to be an excusable compensable delay. Actual losses and expenses are entitled to claim, such as; interest and financing charges, overheads, loss of profit, and cost of claim preparation (Hasweh, 2016).

### **2.4.4 Variation claim**

In the construction industry, the most common type of claim and almost all contracts occur. Once the contract has been awarded, an employer changes the initial scope of work of the contractor and therefore creates variation claims. Usually, every standard form of the contract includes a clause defining what changes become variations and procedure of evaluation (Humphreys, 2016). If the variation is affected by the delay in the critical path of the project, then the EOT claim arises.



#### **2.4.5 Changes claims**

It occurs where the modifications exceed the amount and quantity allotted at the time of the award by the contracting parties. Changes lead to the additional amount, extra time, equitable compensation for time, or both (Joseph, 1993). The contractor is liable to complete the project within the given time period in the contract, adding modifications therein requires additional time for the contractor. This additional time leads to arise EOT claim (Zaneldin, 2006).

#### **2.4.6 Different Site Conditions Claims**

The inspection even starts from the initial stage with the professional. Site condition might differ in the construction stage compare to the tendering stage. The risk will arise from the EOT claims for different site conditions (Zaneldin, 2006).

#### **2.5 Issues due to claims**

Zaneldin (2005), explained: “when received a claim then owner and contractor sometimes come to an agreement concerning the claim and create a change order or a modification, or they may disagree and create a dispute.” In accordance with Ren et al. (2003), “disputed claims can be settled and resolved by negotiation, mediation, arbitration or litigation proceedings.” In research carried out in Ethiopia, according to Dinku and Kahssay (2013), claims affect mainly three sectors; financial impact, impact on the completion of the project time and other claims effects.

Key issues of claim are overruns of cost and time. An overrun of costs is defined as a percentage difference in costs between the project costs and the contract award amount (Ramanathan, Narayanan & Idrus, 2012). A time overrun is the project’s duration difference between the project’s original contract time and its overall actual completion time at the end of the construction period.

According to Dinku and Kahssay (2013), the financial impact has been identified as the most important effect of claims in Ethiopian international projects. In some projects, financial claims reached up to 200-300% of the project cost.

Dinku and Kahssay (2013) further state, once dispute of claim referred to arbitration, the parties begin to see each other as opponents, and that will have a far greater impact, probably more severe than the financial impact may have on the total project life.

## **2.6 Analysis of EOT claims in depth**

It has been shown that most literature references are linked to EOT claims, as explained in previous subheadings. This means that EOT claims are the most prominent type of claims for the construction industry. According to the present subheading, EOT claim examines in depth to determine the causes, the parties responsible, the remedies available, and the effects of EOT claims. The literature reviewed for this current research is presented in attached Appendix 1. It shows 54 previous literature in several places on the topic. The causes, remedies, and effects of EOT claims were derived, and the related parties were classified from these sources.

### **2.6.1 Causes of EOT Claims**

Table 2.1 presents the summary of the causes which are gathered through the previous researches. Accordingly referred to 29 researches on this subject area total of 308 causes have been identified. In that 308 the 65 causes were own delays of the contractor. As EOT claims do not arise due to the contractor fault itself, those they are deducted from the list and derived 243 causes as applicable to the EOT claim.

A thorough analysis of the causes of EOT, it is shown that most of the causes of the EOT claims considered have similarities insignificance. Therefore, the number of causes was reduced by identifying the literal meaning and finally it was able to group the total causes into 38 numbers as discussed in the rest of this chapter. Derived common causes are shown in Table 2.1.

Table 2.1 - List of Causes in Literature

Author	Country	Claim Causes	EOT Causes
Mansfield, Ugwu, and Doran,1994	Nigeria	5	3
FIDIC (1999)		18	18
Ahmed, Azhar, Castillo and Kappagantula, 2002	Florida	4	0
Jayawardene and Panditha (2003)	Sri Lanka	10	5
Yates and Epstein (2006)	America	9	7
Assaf and Al-Hejji (2006)	Saudi Arabia	6	2
Sambasivan and Soon (2007)	Malaysia	10	1
Diab and Sharma (2007)	Dubai,UAE	9	5
G. Sweis, Sweis, Hammad and Shboul, 2008	Jordan	4	1
Danial (2007)	Malaysia	14	12
Abd El-Razek, Bassioni and Mobarak, 2008	Egypt	5	3
Pathiranage (2011)	Sri Lanka	9	4
JCT (2011)		9	9
ICE (2011)		9	9
Jeyakanthan and Jayawardane (2012)	Sri Lanka	7	7
Pourroostam and Ismail (2012)	Cambodia	7	7
Paul (2013)	Hong Kong	25	23
NEC3 (2013)		7	7
Dolage and Rathnamali (2013)	Sri Lanka	51	32
Marzouk and El-Rasas (2014)	Egypt	6	5
Alloh (2014)	Palestine	7	7
Mydin, Sani, Taib and Alias, 2014	Malaysia	6	6
Mpofu, Ochieng, Moobela and Pretorius, 2017	UAE	23	23
Maduranga, Palamakumbura and Dissanayake, 2016	Sri Lanka	5	5
Durdyev, Omarov and Ismail, 2017	Cambodia	3	3
Lessing, Thurnell and Durdyev, 2017	New Zealand	15	15
www.designingbuildings.co.uk, (2017)		13	12
Niazi and Painting (2017)	Afghanistan	6	6
Al-Hazim, Salem and Ahmad, 2017	Jordan	6	6
<b>Total number of Causes</b>		<b>308</b>	<b>243</b>
<b>Total Identified Common EOT Causes</b>			<b>38</b>

The 38 common causes were further identified as responsible parties, such as owners, consultants, and others. These are described in detail in the subsequent sections.

## 2.6.2 Causes of EOT Claims – Owner related

Out of 38 common causes identified in subheading 2.6.1, 16 owner-related causes were derived. Extracted summary of the owner related causes is presented in Table 2.2.

Table 2.2 - Owner related causes in descending order

	Owner related causes	Diab and Sharma (2007)	Yates and Epstein (2006)	Pathirana (2011)	Assaf and Al-Hejji (2006)	G. Sweis, Sweis, Hamad and Shboul, 2008	Abd El-Razek, Bassioni and Mobarak, 2008	Dolage and Rathnamalli (2013)	Paul (2013)	JCT (2011)	NEC3 (2013)	ICE (2011)	FIDIC (1999)	Jayawardene and Panditha (2003)	Jeyakanthan and Jayawardane (2012)	www.designbuildings.co.uk (2017)	Niazi and Painting (2017)	Al-Hazim, Saleh and Ahmad, 2017	Lessing, Thurnell and Durdjev, 2017	Impolu, Ochieng, Mubeta and Pretorius, 2017	Marzouk and El-Rasas (2014)	Pourrosiam and Ismail (2012)	Mydin, Sani, Taib and Alias, 2014	Daniel (2007)	Mansfield, Ujwu, and Doran, 1994	Sambasivan and Soon (2007)	Alloh (2014)	Maduranga, Palamakumbura and Dissanayake, 2016	Durdjev, Omarov and Ismail, 2017
1	Excessive scope changes or variations	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	Impediment and default by the Employer's personnel							X	X	X	X	X	X			X	X	X	X	X	X	X	X	X					
3	Failure to give possession of site		X				X	X	X	X	X	X	X			X				X									
4	Delay in contractors payment by owner			X		X	X									X				X	X				X	X			
5	Postponement or suspension							X	X	X	X	X	X													X	X		
6	Delay of obtaining authority approvals	X						X						X	X	X													
7	Unrealistically short project duration						X											X	X	X									X
8	Awarding to lowest bidder						X												X	X	X								
9	Delay in the supply of materials and goods by the employer							X								X				X				X					
10	The budget is not monitored	X					X											X											
11	Restricted space for operations & material storage						X				X																		
12	Inadequate feasibility studies						X								X														
13	Financial problems of the owner		X																X										
14	Taking Over of Parts of the Works											X																	
15	Too many projects being handled at a time						X																						
16	Ineffective delay penalties						X																						

### 2.6.3 Causes of EOT Claims – Consultant related

Out of 38 common causes identified in subheading 2.6.1, 13 consultant-related causes were derived. Extracted summary of the consultant related causes is presented in Table 2.3.

Table 2.3 - Consultant related causes in descending order

		ICE (2011)	Paul (2013)	JCT (2011)	NEC3 (2013)	FIDIC (1999)	Jayawardene and Panditha (2003)	Jeyakanthan and Jayawardane (2012)	www.designingbuildings.co.uk (2017)	Durdyev, Omarov and Ismail, 2017	Lessing, Thurnell and Durdyev, 2017	Mpofu, Ochieng, Moobela and Pretorius, 2017	Alloh (2014)	Maduranga, Palamakumbura and Dissanayake, 2016	Diab and Sharma (2007)	Yates and Epstein (2006)	Niazi and Paining (2017)	Al-Hazim, Salem and Ahmad, 2017	Pourrostam and Ismail (2012)	Dolage and Rathnamali (2013)	Daniel (2007)	Mydin, Sani, Salim and Alias, 2014	Pathiranege (2011)	Mansfield, Ugwu, and Doran, 1994	Sambasivan and Soon (2007)
1	Changes by Consultant	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	Defective designs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	Approvals delay by Consultant(construction methods, major changes, tests & inspection)	X				X				X	X									X	X	X			
4	Late instructions	X	X	X	X	X				X	X									X	X				
5	Incomplete Contract Document		X				X				X	X								X	X	X			
6	Erroneous cost estimate										X				X					X				X	
7	Poor coordination with contractors									X	X									X				X	
8	Incomplete Tender Document					X	X				X														
9	Inadequate Consultant staff										X									X	X				
10	Delay in approving payments					X														X					
11	Conflict between contractors				X															X					
12	Insufficient controlling and monitoring										X									X					
13	Delay in approving extra work and variations																			X					

## 2.6.4 Causes of EOT Claim – Other related

Out of 38 common causes identified in subheading 2.6.1, nine others-related causes were derived. Extracted summary of the other related causes is presented in Table 2.4. In this category included factors are not either owner- or consultant-related.

Table 2.4 - Others related causes in descending order

	Others related causes	Yates and Epstein (2006)	Paul (2013)	JCT (2011)	NEC3 (2013)	ICE (2011)	FIDIC (1999)	Jayawardene and Panditha (2003)	Pathirana (2011)	Jeyakanthan and Jayawardane (2012)	Dolage and Rathnamali (2013)	www.designingbuildings.co.uk (2017)	Danial (2007)	Al-Hazim, Salem and Ahmad, 2017	Lessing, Thurnell and Durdyyev, 2017	Lessing, Thurnell and Durdyyev, 2017	Pourrostam and Ismail (2012)	Mydin, Sani, Taib and Alias, 2014	Maduranga, Palamakumbura and Dissanayake, 2016	Miarzouk and El-Rasas (2014)	Alloh (2014)	Odeh and Battaineh (2002)	Mansfield, Ugwu, and Doran, 1994	Niazi and Painting (2017)
1	Incliment weather	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
2	Differing site conditions	X	X			X	X	X	X		X	X				X		X	X	X				
3	Force majeure	X	X	X	X		X				X	X									X			
4	Delay of Statutory undertaker and utility company		X	X	X		X					X							X			X		X
6	Price fluctuations													X							X		X	X
5	Changes in statutory requirements						X					X												
8	Restricted access to site and surroundings										X					X								
7	Political influence										X	X												
9	Disputes with neighboring owners																							

## 2.6.5 Remedies for EOT Claim – Owner related

The 46 remedies found related to owners were based on several recent researches (A tabulated summary of the literature review is included in Appendix 05). A thorough analysis of the remedies revealed that most of the remedies considered had significance similarities. Therefore, the numbers of remedies have been reduced by using literal meaning. Finally, it was able to group the total remedies into 19 numbers, as shown in Table 2.5.

Table 2.5 - Owners related Remedies in descending order

	Owners related Remedies	Mahamid, Bruland and Dmaidi, 2011	Yates and Epstein (2006)	Assbeihat (2016)	Sambasivan and Soon (2007)	Odeh and Battaineh (2002)	Mansfield, Ugwu, and Doran, 1994	Sullivan and Harris (1986)	Samarakoon (2011)	Seboru (2015)	Pourrostam and Ismail (2012)	Mydin, Sani, Taib and Alias, 2014	Al Jurf and Beheiry (2012)
1	On time payments	X	X	X	X								
2	Check Contractor's resource availability, past performances & capabilities before award lowest bidder	X		X	X	X							
3	Provide accurate design		X				X						
4	Sufficient time for tender preparation		X			X	X						
5	Improve communication and coordination	X						X	X				
6	Ensure sufficient finance before start the project						X			X	X		
7	Speed up approval procedures with allowing sufficient funds		X							X		X	
8	Choose experienced consultant		X					X			X		
9	Not make major changes			X	X				X				
10	Proper in detailed site investigations	X										X	
11	Introduce new procurement methods (e.g. D&B, Partnering etc)					X							
12	Agreement with Contractor on delivery schedules of material and equipment						X				X		X
13	Establish realistic project duration		X						X				
14	Quick decisions to solve problems			X	X								
15	Conducting Training programs	X											
16	Programs make by qualified and experienced personnel						X						
17	Consider available materials during planning and designing stage												X
18	Appoint experience contractors		X										
19	Introduce intensive mechanism early completion and enforce LD for delays					X							

### 2.6.6 Remedies for EOT Claim – Consultant related

Reviewing several recent researches the 14 remedies are found relating to consultants (A tabulated summary of the literature review is included in Appendix 06). In the process of detail analysis on the remedies, it was discovered that most of the remedies have similarities in meaning. Consequently, the numbers of remedies have been reduced by using their literal meaning to a manageable level. Likewise, finally it was able to group the total remedies into nine numbers as illustrated in Table 2.6.

Table 2.6 - Consultants related Remedies in descending order

	<b>Consultants related Remedies</b>	Marzouk and El-Rasas (2014)	Assbeihat (2016)	Sambasivan and Soon (2007)	Mahamid, Bruland and Dmaid, 2011	Seboru (2015)
1	Speed up resolve disputes	X	X	X		
2	Provide comprehensive documents on time			X	X	
3	On-time approval of drawings		X	X		
4	Be fair during evaluating the contractor's work				X	
5	Improve the relationship between parties				X	
6	Speed up finalizing claims					X
7	Establish proper mechanism to evaluate variations	X				
8	Monitor the work closely by timely manner		X			
9	Do inspection in appropriate time			X		



## 2.6.7 Effects due to EOT Claim

Refer to several recent reteaches found the 17 effects of EOT claims (A tabulated summary of the literature review is included in Appendix 07). In the process of in-depth analysis of the effects, it was revealed that most of the effects considered have similarities in meaning. Therefore, the numbers of effects have been reduced by using literal meaning to a manageable level. Likewise, finally it was able to group the total effects into nine numbers, as shown in Table 2.7.

Table 2.7 - Effects in descending order

	Effects of EOT claims	Al Jurf and Beheiry (2012)	Zaneldin, (2006)	Ravisankar and Anandakumar (2014)	Aibinu and Jagboro (2002)	Kaming, Olomolaiye, Holt and Harris, 1997	Kikwasi (2012)	Tushar, Sohiti, Vaishant and Mukesh, 2016	James (2014)	Abedi and Mohammad (2011)	Assbeihat (2016)	Assaf and Al-Hejji (2006)	Pourrostam and Ismail (2012)	Chan and Kumaraswamy (1997)	Frimpong, Oluwoye and Crawford, 2003	Koushki, Al-Rashid and Kartam, 2005	Samarakoon (2011)	Sambasivan and Soon (2007)	Mydin, Sani, Taib and Alias, 2014	Manavazhi and Adhikari (2002)	Haseeb, Bibi and Rabbani, 2011	Abedi & Mohammad (2011)	
1	Time overrun	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
2	Cost overrun	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X	X	X			
3	Disputes		X		X		X	X	X	X	X		X				X	X	X				
4	Abandonment		X		X			X	X	X	X		X					X	X		X		
5	Arbitration								X	X	X		X				X	X	X				X
6	Litigation		X		X			X	X	X	X		X					X	X				
7	Idling resources						X		X														
8	Negative social impact						X																
9	Slow down growth of construction sector																				X		

## **2.7 Summary of the Literature Review**

In the review of the previous literature, it could be identified that there are various numbers of causes, remedies, and effects considered by various authors. Numbers of causes, remedies, and effects considered in each previous literature varied considerably. It has been identified that there are similarities in the meaning of most of the causes, remedies, and effects considered therein. Therefore, most of the similar causes, remedies, and effects have been able to group together and ultimately the following six lists (owner related causes, consultant related causes, other related causes, owner related remedies, consultant related remedies, and effects) has been identified.

These identified factors were taken to prepare the research questions. A pilot survey was carried before the questionnaire was distributed, and it was explained under the next chapter.

## **CHAPTER 3: Research Methodology**

### **3.1 Introduction**

This chapter is structured to explain the research process and methodology, such as how the findings of the literature review continue to research in Sri Lanka, research design, research technique, research method, sample selection, data collection, and data analysis are herewith explained in depth.

The intention of this research was to find the answers in relating to building construction projects in Sri Lanka, such as;

what are the most significant causes of EOT claims and responsible parties from the building projects in Sri Lanka?

what are the available remedies with applicable parties and whether they are suitable for building projects in Sri Lanka?

what are the effects of EOT claims and whether they are affecting to building projects in Sri Lanka.?

### **3.2 Research Design**

Kagioglou, Cooper, Aouad and Sexton, 2000, state three key steps (refer Figure 3.1) in research design such as; identification of the research philosophy, choosing of suitable research approach and final step as the research techniques selection. Refer to Figure 3.1, the sequence between these three steps as follows; based on the research approach, the selection of research techniques depend, based on research philosophy, the selection of research approach depends.



Figure 3.1: Nested Research Methodology  
(Kagioglou, Cooper, Aouad & Sexton, 2000)

### **3.3 Research Philosophy**

In the research design, the first step is research philosophy. According to, Lincoln and Guba (2000), research philosophy (research paradigm) is the basic belief system and which guide the researcher to select an appropriate research strategy.

### **3.4 Research Approach**

There are two main research approaches; quantitative approach and qualitative approach (Naoum, 2013). The qualitative approach enables the researcher to study whole population perceptions as individuals or groups. This method is advantageous for researchers to understand, opinions, and views of people and data gathered are detailed and rich in content (Fellows & Liu, 2015). Besides, the qualitative approach includes case study research, grounded theory, action research, and ethnography.

A quantitative approach enables the researcher to obtain; factual data, the relationship between facts and relationship of theories in the study, findings of previous research (Kraemer 2002 cited Jayasena 2009). The quantitative approach also includes survey researches and experimental researches.

### **3.5 Selection of survey approach**

A case study helps to examine an occurrence in its natural situation. However, the researcher cannot have the ability to control the phenomenon, but they can control the examination time and limit the scope. In the case of independent and dependent variables, the case developer may or may not visibly outline them. Case studies are better suited if the researcher determines the relationship between setting and occurrence of interest (Kraemer 2002 cited Jayasena 2009). For this research, the phenomenon of interest is not essential.

Experiments helpful to an inspection of an occurrence in a controlled setting. The process involves the researcher manipulating variables and observing effects which are depending manipulated variables. Enable researchers to control the condition and manipulation of independent variables, however, can only study phenomena in the present. Experiments therein are well suited for research projects involving comparatively small and well - defined concepts for people or small groups (Kraemer 2002 cited Jayasena 2009).

Survey research falling under the quantitative approach, its enabling gather information from selected samples of industry experts by asking questions and expecting answers on their opinions. The most commonly using descriptive survey research is survey research and involving collect the data at a particular point of time. Survey research mostly focuses on getting people's opinions, behaviors, actions, thinking, interactions, and plans (Burns, 2000).

According to the above justification, it is clear that case studies and experiments are not appropriate research approaches for conducting this research. Accordingly, factual information from a large number of industry experts enables it to receive through survey research. Therefore, survey research selected as an appropriate method.

### **3.6 Research Technique**

The research technique of the questionnaire was chosen as the appropriate data collection method. The survey was conducted by using the Delphi technique comprising three rounds by using a questionnaire survey. The questionnaire is prepared using the knowledge gained from the literature review in the different locations around the world. A pilot survey was conducted with a selected expert panel to refine the questionnaire, which led to the final questionnaire.

The purpose of this survey research is to identify the most significant causes, remedies, and effects of EOT claim with the related parties. To the success of the task, it should be a common agreement from the industry experts by using their knowledge and experiences. Distributing questionnaire among a large number of people and obtained their answers in first hand definitely create in inaccurate opinions due to; busy time nature of the work, no opportunity to re-thinks given opinions, limited time for thinking out of work, the bias of opinions as obey to their employers, an opportunity not taking to refer the group opinion to provide answers.

Mitigating the above-mentioned challenges as the best approach in this survey, the Delphi technique has been chosen, which will explain in detail in the subheading 3.8.

### **3.7 Pilot survey**

The pilot survey offers a test run for the questionnaire. This process conducting in order to testing of such details; wordings of questions, identify unclear questions, testing of data collection technique, and measure the efficiency of respondents (Naoum, 2013). The study was conveyed to expert panels with over ten years of experience in the construction industry by distributing the questionnaire. To evaluate the questionnaire, four expert panel members participated. To achieve the research objectives, the panel was asked to verify the validity of the questionnaire. In sequence experts, commentaries and proposals were taken into consideration. All the proposed commentaries and alterations were discussed in detail with the research supervisor

prior to making any changes. Finally, some minor changes, modifications, addition, omission, were incorporated into the questionnaire, and the final questionnaire was formulated.

### **3.8 Selection of Delphi Technique**

As stated by Linstone and Turoff (1975), the Delphi technique has been started to use since 1950. This was developed at the Rand Corporation for forecasting possible magnitudes of a nuclear attack in the USA. However, other sectors also Delphi technique was adopted to use in later, such as; taking decisions in management and social science, the education industry, and business (Dunham, 1998).

Delphi technique defined by Fischer (1978), as “a method for collecting and refining expert opinions for the purpose of arriving at a consensus.” This is a dominant process for acquiring objective opinions in the areas with a top of subjectivity (Brady, 2015).

According to Brown (1969), Gupta and Clarke 1996, Linstone and Turoff 1975 cited Howze and Dalrymple (2004), “the Delphi technique defined as a technique designed to elicit opinions from a group with the aim of generating a group response; as a technique, that produces, refines, and draws upon the collective opinion and expertise of a panel of experts; and as an attempt at creating a sort of collective human intelligence.”

The usage of Delphi is becoming largely adopted for numerous complex areas with the purpose of reaching a consensus. Additionally, to receive unbiased information from the chosen industry panel of experts, the Delphi method is the highly standardized method of communication (Chan, Yung, Lam, Tam & Cheung, 2001).

The Delphi process is led by several questioners (rounds) to individuals as a group (enable to have interviews too) by repeating the same questions with providing group results of previous rounds. Delphi provides the true value of opinions, not just the mean (Helmer 1983 cited Jayasena, 2009).

The additional benefit of this Delphi process is that members of experts are not required to work together or to keep a connection with each other. Presenting group results to panels are anonymous and providing the acquired percentage for each question. Likewise, participants get the opportunity to reconsider their answer after seeing the group result. Hence, most reliable answers can be received from this Delphi technique, which led to the selection of this technique for current research.

### **3.9 Selection of Sample**

The success of the Delphi questionnaire survey depends on the selection of the samples. Among a large population, careful selection of sample to a smaller group is an important task (Punch, 2005). Respectively Skulmoski (2007) states that the critical factor of the Delphi method is the selection of participants.

The following criteria were used to select eligible participants (panel of experts) for conducting a questionnaire survey.

- Professional experienced in the construction sector in Sri Lankan
- Over ten years' experienced in the construction industry
- Engagement and playing a managerial role in construction projects
- Sound knowledge and dealing with construction claims

At first, 40 experts were selected for the panel. However, all three Delphi rounds were attended by only 33 experts. The panel includes the experts;

- Senior-Quantity Surveyors (SQS),
- Senior-Project Managers (SPM),
- Senior-Architects (SA),
- Senior-Engineers (SE).



Experts were selected in Sri Lanka private and public sector construction projects. In addition to that considered combinations in selecting the type of organizations which they were work, such as; client, consulting, and contracting. Table 3.1 shows the composition of the expert panel for the questionnaire survey.

Table 3.1 - Composition of experts' panel

<b>Profession</b>	<b>Numbers</b>	<b>Organization</b>	<b>Numbers</b>
Project manager	6	Consultant	20
Engineer	2	Contractor	8
Quantity Surveyors	23	Client	5
Architect	2		
<b>Total</b>	<b>33</b>	<b>Total</b>	<b>33</b>

### **3.10 Design of Delphi Rounds**

Delphi survey was carried out in three rounds in the manner as described below.

#### **3.10.1 Round one of Delphi Survey**

During this first round, 40 questionnaires were distributed to the selected experts. However, only 33 experts responded to the survey and took part. The experts were asked to identify the applicability of the causes, remedies, and effects of EOT claims to Sri Lankan Building construction projects. Also, in this first round, the panel was asked to introduce any different causes, remedies, or effects based on their experienced and knowledge. Refer the round one of Delphi questionnaire enclosed under Appendix 02 for more details.

### 3.10.2 Round two of Delphi Survey

Round two also conducted with the same panel of experts and all experts who were participated in round one also participated in this round. However, few new questions were incorporated to questionnaire which was introduced by some of the experts in round one. The experts were asked to determine the level of importance with the provided scale.

The scale given for causes and remedies are as follows;

Not applicable	-	0
Not significant	-	1
Slightly significant	-	2
Significant	-	3
Very significant	-	4
Extremely significant	-	5

The effects are shown in the following scale ;

Strongly disagreed	-	0
Disagreed	-	1
Slightly agreed	-	2
Neutral	-	3
Agreed	-	4
Strongly agreed	-	5

Refer Appendix 03 for the round two Delphi questionnaires.

### 3.10.3 Round three of Delphi Survey

The same questionnaire was presented in round three, but with percentages for each question in scale-wise. The provided percentages were calculated according to the number of responses given levels of scale (significant level) for each question dividing by the total number of responses (i.e., 33) and based on that deriving a percentage. The response scale is based on Delphi feedback in the second round. Each respondent's answer was also individually marked in bold text in order to recognize their response. Accordingly, after knowing group feedback, participants were asked to confirm their

answers or make any changes. They asked if they want to confirm the same answer given in round two, leave the text bolt mark box as it is or underlines a different box if they must be changed.

The round three used the same scale applied for round two. Appendix 04 contains the round three Delphi questionnaire.

### **3.11 Data Analysis**

#### **3.11.1 Binomial test**

The binomial test adopted for Delphi round one results and accordingly passes questions carry forward to the round two questionnaires. Subsequently, from the causes, remedies, and effects at least 50% of the population, which would be accepted to exist in building construction projects in Sri Lanka were identified via this test.

From the Binomial Test on a sample of size 33 as illustrated in Table 3.2, if a cause, remedy or effect is accepted by 16 or lesser number of respondents, it infers that less than 50% of the population has accepted that question and could not be taken to next list for round two. Thereinto exists any question, and it might be accepted by above 16 experts, which infer the cumulative percentage as 50%.

$$P(X=r) = nCr p^r (1-p)^{n-r}$$

Where,

$nCr$  - Numbers of arrangements that could have in a sample

$n$  - Sample size

$r$  - Frequency of positive responses

$p$  - Probability of obtaining a response 'Yes'

$1-p$  - Probability of obtaining a response 'No'

With the selected sample, tested for the probability  $p = 0.5$ .

Table 3.2– Results of the Binomial test

r	$nCr=r!/r!(n-r)!$	Probability	Cummulative Probability
1	33	0.00000000384	0.00%
2	528	0.00000006147	0.00%
3	5456	0.00000063516	0.00%
4	40920	0.00000476371	0.00%
5	237336	0.00002762955	0.00%
6	1107568	0.00012893789	0.02%
7	4272048	0.00049733184	0.07%
8	13884156	0.00161632849	0.23%
9	38567100	0.00448980136	0.68%
10	92561040	0.01077552326	1.75%
11	193536720	0.02253063954	4.01%
12	354817320	0.04130617250	8.14%
13	573166440	0.06672535557	14.81%
14	818809200	0.09532193653	24.34%
15	1037158320	0.12074111961	36.42%
16	1166803110	0.13583375956	50.00%
17	1166803110	0.13583375956	63.58%
18	1037158320	0.12074111961	75.66%
19	818809200	0.09532193653	85.19%
20	573166440	0.06672535557	91.86%
21	354817320	0.04130617250	95.99%
22	193536720	0.02253063954	98.25%
23	92561040	0.01077552326	99.32%
24	38567100	0.00448980136	99.77%
25	13884156	0.00161632849	99.93%
26	4272048	0.00049733184	99.98%
27	1107568	0.00012893789	100.00%
28	237336	0.00002762955	100.00%
29	40920	0.00000476371	100.00%
30	5456	0.00000063516	100.00%
31	528	0.00000006147	100.00%
32	33	0.00000000384	100.00%
33	1	0.00000000012	100.00%

### 3.11.2 Relative Importance Index (RII)

Analysis for collected data used the common analytical method of Relative Importance Index (RII) most researchers have been used to analyze data. RII equation described as below,

**The equation for Causes of EOT claims and Remedies**

$$RII = \frac{\sum_{i=1}^4 W_i X_i}{\sum_{i=1}^4 X_i}$$

Where,

$W$ = Weight assigned to the  $i^{\text{th}}$  response, for instance 0, 1,2,3,4 and 5.

$X_i$ = frequency of  $i^{\text{th}}$  responses percentage.

$i$  = Response category index, for instance,

Not applicable	-	0
Not significant	-	1
Slightly significant	-	2
Significant	-	3
Very significant	-	4
Extremely significant	-	5

### Equation for Effects

$$R_{II} = \frac{\sum_{i=1}^4 W_i X_i}{\sum_{i=1}^4 X_i}$$

Where,

$W$ = Weight assigned to the  $i^{\text{th}}$  response, for instance 0, 1,2,3,4 and 5.

$X_i$ = frequency of  $i^{\text{th}}$  responses percentage.

$i$  = Response category index, for instance,

Strongly disagreed	-	0
Disagreed	-	1
Slightly agreed	-	2
Neutral	-	3
Agreed	-	4
Strongly agreed	-	5

### 3.12 Expert validation

In the final results, the expert panel for expert validation was interviewed. Four experts were present in the panel. The results were validated and recommended for use by the panel.

## **CHAPTER 4: Presentation and analysis of data**

### **4.1 Introduction**

Three questionnaire rounds were carried out in Delphi and collected the data from experts as the process explained in the methodology chapter. Accordingly, this chapter is structured to interpret the data analysis process and the presentation of outcomes.

### **4.2 Delphi Round One**

The round one of the Delphi survey is conducted to identify the applicability of the causes, remedies, and effects in relating to EOT claim in building construction projects in Sri Lanka and to identifying any new items. A few experts have introduced some new items and added them to the list. The new items incorporated by marking "new" under the relevant list of factors in subsequent sections (Table 4.1, 4.2, 4.3, 4.4, 4.5, and 4.6). The round one questionnaire is attached under Appendix 02 for more details.

#### **4.2.1 Causes of EOT Claims – Owner related**

Table 4.1 presents the owner-related causes accepted by experts as applicable to Sri Lanka with additional factors. Results were analyzed the number of responses given answers for every 19 questions and dividing by total respondents 33 and deriving percentage. According to that derived percentage of responses organized in descending order and shows in Table 4. 1. Moreover, two experts have added three more client-related causes for EOT claims as requested in this round one as follows;

17 - Strict safety procedure and punishments,

18 - Delaying NSC nomination,

19 - Errors in setting out information.

Those newly introduced factors are added to the list and marked as “new.”

Table 4.1 – Results, Delphi Round 1, Owner related Causes

	Summary of Causes	Total No of experts	No of experts Accepted	Accepted %
1	Excessive scope changes or variations	33	28	84.85%
2	Taking Over of Parts of the Works	33	28	84.85%
3	Delay in contractor's payment by the owner	33	28	84.85%
4	Unrealistically short project duration	33	28	84.85%
5	Awarding to the lowest bidder	33	28	84.85%
6	Delay in the supply of materials and goods by the employer	33	27	81.82%
7	Delay of obtaining authority approvals	33	25	75.76%
8	Failure to give possession of the site	33	24	72.73%
9	Restricted space for operations & material storage	33	22	66.67%
10	Financial problems of the owner	33	18	54.55%
11	Inadequate feasibility studies	33	18	54.55%
12	Impediment and default by the Employer's personnel	33	6	18.18%
13	Postponement or suspension	33	4	12.12%
14	The budget is not monitored	33	3	9.09%
15	Too many projects being handled at a time	33	2	6.06%
16	Ineffective delay penalties	33	1	3.03%
17	Strict safety procedure and punishments	33	New	New
18	Delaying NSC nomination	33	New	New
19	Errors in setting out information	33	New	New

The 11 owner related causes of EOT claims were accepted by the experts as they apply to Sri Lankan building construction projects by more than 50%. Causes of EOT claims; number 12 to 16 “Impediment and default by the Employer’s personnel”, “Postponement or suspension”, “Ineffective delay penalties”, “The budget is not monitored”, “Too many projects being handled at a time”, “Ineffective delay penalties” were accepted as applicable only by six (18.18%), four (12.12%), three (9.09%), two (6.06%) and one (3.03%) experts respectively.

Refer to Binomial Test on a sample of size 33 (refer Table 3.2 in methodology chapter), to exist any cause it could be accepted by above 16 experts, which infer the cumulative percentage as 50%. Based on that, from a selected population, the experts believe only 11 causes to exist and taken for Delphi round two.

Accordingly, those 11 owner related causes and newly introduced three causes were taken for round two. The expectation of the second round is to identify the level of their significance, such as each owner related causes of EOT claims in relating to building construction projects in Sri Lanka.

#### 4.2.2 Causes of EOT claims – Consultant related

Table 4.2 presents the consultant-related causes accepted by experts as applicable to Sri Lanka in descending order as the number of experts accepted. In the first round, as requested, one expert has added one more owner related causes of EOT claims as follows. This new question added up to the list as marked by “New.”

14 - Bill of quantity items, drawings & specification inconsistencies

Table 4.2 – Results, Delphi round 1, Consultant related Causes

	Summary of Causes	Total No of experts	No of experts Accepted	Accepted %
1	Defective designs	33	31	93.94%
2	Changes by Consultant	33	28	84.85%
3	Delay in approving payments	33	27	81.82%
4	Late instructions	33	26	78.79%
5	Approvals delay by Consultant (Construction methods, Major changes, tests & inspection)	33	26	78.79%
6	Delay in approving extra work and variations	33	23	69.70%
7	Incomplete Tender Document	33	22	66.67%
8	Incomplete Contract Document	33	22	66.67%
9	Erroneous cost estimate	33	20	60.61%
10	Poor coordination with contractors	33	13	39.39%



	Summary of Causes	Total No of experts	No of experts Accepted	Accepted %
11	Insufficient controlling and monitoring	33	5	15.15%
12	Conflict between contractors	33	5	15.15%
13	Inadequate Consultant staff	33	4	12.12%
14	Bill of quantity items, drawings & specification inconsistencies	33	1	New

More than 50 percent of experts accepted nine consultant - related causes of EOT claims as applicable to Sri Lanka. Cause; number 10 to 13, “Poor coordination with contractors”, “Insufficient controlling and monitoring”, “Conflict between contractors”, “Inadequate Consultant staff” were accepted as applicable only by 13 (39.39%), five (15.15%), five (15.15%) and four (12.12%) experts respectively.

From the Binomial Test on a sample of size 33 (refer Table 3.2 in methodology chapter), infer that the population (selected experts) believes that only those nine causes exist to taken for Delphi round two.

Accordingly, those nine consultant related causes and newly introduced one cause were taken for round two. The expectation of the second round is to identify the level of their significance, such as each consultant related causes of EOT claims in relating to building construction projects in Sri Lanka.

#### **4.2.3 Causes of EOT claims – Other related**

Table 4.3 introduces the other causes accepted by experts as applicable to Sri Lanka with additional factors in the decreasing range of accepted experts. Additional factors are marked as “New.”

Two experts have added two more other-related causes for EOT claims as requested in this round one as follows;

9 - Different physical conditions as planned during the tender stage,

10 - Market Inflation.

Table 4.3 – Results, Delphi round 1, Other related Causes

	Summary of Causes	Total No of experts	No of experts Accepted	Accepted %
1	Inclement weather	33	27	81.82%
2	Force majeure	33	26	78.79%
3	Restricted access to site and surroundings	33	26	78.79%
4	Changes in statutory requirements	33	23	69.70%
5	Delay of Statutory undertaker and utility company	33	20	60.61%
6	Disputes with neighboring owners	33	18	54.55%
7	Political influence	33	12	36.36%
8	Price fluctuations	33	8	24.24%
9	Different physical conditions as planned during the tender stage	33	1	New
10	Market Inflation	33	1	New

Six other related causes of EOT claims were accepted as applicable to Sri Lanka by more than 50% of the experts. Causes; number seven and eight, “Political influence” and “Price fluctuations” were accepted as applicable only by 12 (36.36%) and eight (24.24%) experts respectively.

According to the Binomial test results illustrated in Table 3.2 in methodology chapter that infer the population (i.e. all the professionals in the Sri Lankan construction industry) in the selected categories in the experts believes that only those six causes to be exist (i.e. min requirement for a causes to be considered for next round). Therein these six causes are carry forward to round two of Delphi with the newly introduced two causes.

For the second round of Delphi, the above analysis factors were used. Round two is conducted to identify the level of significance of each other related causes of EOT claim in relating to building construction projects in Sri Lanka.

#### 4.2.4 Remedies for EOT claims – Owner related

Table 4.4 presents the remedies accepted by experts as applicable to Sri Lanka with additional factors in descending order as the number of experts accepted. That bellow mentioned additional four remedies added to the list as marked in “New.”

As requested in this round one, four experts have added four more other related remedies for EOT claims as follows;

20 - Not to change Contractor’s sequence of operation only benefit to the owner (method statement)

21 - Get the Main Contractor’s consent prior to appointing other contractors (NSC or Specialist sub-contractor)

22 - Arrange to obtained approvals for the use of foreign labor

23 - Improve Pre –Contract estimations

Table 4.4 – Results, Delphi round 1, Owner related Remedies

	Summary of Remedies	Total No of experts	No of experts Accepted	Accepted %
1	On time payments	33	33	100.00%
2	Speed up approval procedures with allowing sufficient funds	33	33	100.00%
3	Establish realistic project duration	33	33	100.00%
4	Choose experienced consultant	33	33	100.00%
5	Appoint experienced contractors	33	33	100.00%
6	Check Contractor's resource availability, past performances & capabilities before award lowest bidder	33	31	93.94%
7	Programs make by qualified and experienced personnel	33	31	93.94%
8	Introduce intensive mechanism early completion and enforce LD for delays	33	31	93.94%

	Summary of Remedies	Total No of experts	No of experts Accepted	Accepted %
9	Sufficient time for tender preparation	33	28	84.85%
10	Improve communication and coordination	33	28	84.85%
11	Quick decisions to solve problems	33	28	84.85%
12	Ensure sufficient finance before starting the project	33	27	81.82%
13	Not make major changes	33	27	81.82%
14	Agreement with Contractor on delivery schedules of material and equipment	33	25	75.76%
15	Consider available materials during the planning and designing stage	33	20	60.61%
16	Proper in detailed site investigations	33	19	57.58%
17	Arrange to Provide complete design	33	17	51.52%
18	Introduce new procurement methods (e.g. D&B, Partnering etc.)	33	17	51.52%
19	Conducting Training programs	33	4	12.12%
20	Not to change the Contractor's sequence of operation only benefitted to the owner (method statement)	33	1	New
21	Get the Main Contractor's consent prior to appointing other contractors (NSC or Specialist sub-contractor)	33	1	New
22	Arrange to obtained approvals for the use of foreign labor	33	1	New
23	Improve Pre –Contract estimations	33	1	New

More than 50% of the experts agreed to eighteen owner-related remedies for EOT claims in Sri Lanka. Remedy number, 19 of “Conducting Training programs” were accepted as applicable only by four (12.12%) experts. From the Binomial test (refer Table 3.2 in methodology chapter), conclude that the population (i.e. all the professionals in the Sri Lankan construction industry) in the selected categories in the experts believe that only those 18 remedies exist (i.e. min requirement for a remedies to be considered for next round).

Above selected 18 and newly introduced four remedies were taken for the second round of Delphi. The second round conducted to identify the level of significance of owner-related remedies for EOT in building construction projects in Sri Lanka.

#### 4.2.5 Remedies for EOT claims – Consultant related

The remedies accepted by experts as applicable in Sri Lanka are presented in Table 4.5 with additional remedies in decreasing order, as accepted by the number of experts. As requested in this round one, the one expert has added one more consultant related remedy for EOT claims as follows;

10 - Analyses actual resources requirement for smooth operation and include to contract.

This new remedy added to the list as marked by “New.”

Table 4.5 – Results, Delphi round 1, Consultant related remedies

	Summary of Remedies	Total No of experts	No of experts Accepted	Accepted %
1	Monitor the work closely by the timely manner	33	32	96.97%
2	Provide comprehensive documents on time	33	31	93.94%
3	Speed up resolve disputes	33	30	90.91%
4	Establish proper mechanism to evaluate variations	33	29	87.88%
5	Do inspection in appropriate time	33	26	78.79%
6	On-time approval of drawings	33	23	69.70%
7	Speed up finalizing claims	33	17	51.52%
8	Be flexible while evaluating the contractor’s Work	33	17	51.52%
9	Improve the relationship between parties	33	4	12.12%
10	Analyzed actual resources requirement for smooth operation and include to contract	33	1	New

More than 50% of the experts accepted eight remedies associated with the consultants for EOT claims in Sri Lanka. Remedy numbers nine of “Improve the relationship between parties” were accepted as applicable only by four (12.12%) experts.

As explained in methodology chapter in Binomial test (refer Table 3.2), it is infer that the population (i.e. all the professionals in the Sri Lankan construction industry) in the selected categories in the experts believe that only those eight remedies exist (i.e., min requirement for a remedies to be considered for next round). For the second round of Delphi, these analyzed and qualified factors with newly introduced one factor were used to recognize the importance of each remedy in Sri Lankan building construction projects.

#### 4.2.6 Effects due to EOT Claims

Table 4.6 illustrated the effects accepted by experts as applicable to Sri Lanka in descending order.

Table 4.6 – Results, Delphi round 1, Effects

	Summary of Effects	Total No of experts	No of experts Accepted	Accepted %
1	Disputes	33	31	93.94%
2	Time overrun	33	30	90.91%
3	Cost overrun	33	30	90.91%
4	Arbitration	33	27	81.82%
5	Litigation	33	25	75.76%
6	Idling resources	33	25	75.76%
7	Negative social impact	33	22	66.67%
8	Abandonment	33	19	57.58%
9	Slow down growth of the construction sector	33	10	30.30%

More than 50 percent of experts accepted eight effects of EOT claims as applicable to Sri Lanka. However, remedy nine, which is "Slow growth in construction," has been accepted by 10 (30.30 %) experts as applicable.

Refer to Binomial test results presented in Table 3.2 in methodology chapter concluded that the population (i.e., all the professionals in the Sri Lankan construction industry in the selected categories) in the experts believe that only those eight effects exist (i.e., min requirement for effects to be considered for next round).

For the second round of Delphi, the above factors were used to determine the degree of significance of each impact of the EOT claims in Sri Lankan building construction projects.

### **4.3 Delphi Round Two**

The aim of Delphi round two questionnaires (Appendix 03) was to enable the expert to re-examine their views of Delphi round one and to mark their opinions at a significant level using the Likert scale. Scales are given with the recited values, as mentioned in the methodology section.

The 33 questionnaires have been distributed to 33 panels of experts and replies from all 33 experts have been received.

#### **4.3.1 Causes of EOT claims - Owner, Consultant and Other related**

Table 4.7 summarizes the answers provided by the experts to the Delphi Round Two questionnaire.

Table 4.7 – Results Delphi round 2, Causes related to Owners, Consultants and Others

	<u>Owner related causes</u>	Extremely significant	Very significant	Significant	Slightly significant	Not significant	Not applicable
1	Financial problems of the owner	21%	24%	36%	12%	6%	0%
2	Inadequate feasibility studies	36%	33%	18%	6%	6%	0%
3	Restricted space for operations & material storage	15%	21%	42%	15%	6%	0%
4	Failure to give possession of site	39%	33%	24%	3%	0%	0%
5	Delay of obtaining authority approvals	39%	39%	18%	3%	0%	0%
6	Delay in the supply of materials and goods by the employer	45%	36%	15%	3%	0%	0%
7	Excessive scope changes or variations	36%	27%	30%	6%	0%	0%
8	Taking Over of Parts of the Works	9%	27%	52%	12%	0%	0%
9	Delay in contractor's payment by owner	45%	36%	15%	3%	0%	0%
10	Unrealistically short project duration	42%	39%	12%	3%	3%	0%
11	Awarding to lowest bidder	0%	3%	30%	48%	12%	6%
12 New	Strict safety procedure and punishments	9%	12%	15%	58%	6%	0%
13 New	Delaying NSC nomination	21%	18%	55%	6%	0%	0%
14 New	Errors in setting out information	18%	9%	9%	55%	9%	0%
	<u>Consultant related causes</u>						
1	Erroneous cost estimate	6%	21%	45%	27%	0%	0%
2	Incomplete Tender Document	12%	42%	39%	6%	0%	0%
3	Incomplete Contract Document	64%	33%	3%	0%	0%	0%
4	Delay in approving extra work and variations	27%	12%	58%	3%	0%	0%
5	Late instructions	58%	15%	27%	0%	0%	0%
6	Approvals delay by Consultant (Construction methods, Major changes, tests & inspection)	42%	33%	24%	0%	0%	0%
7	Delay in approving payments	52%	27%	21%	0%	0%	0%
8	Changes by Consultant	3%	21%	18%	55%	3%	0%



	<u>Owner related causes</u>	Extremely significant	Very significant	Significant	Slightly significant	Not significant	Not applicable
9	Defective designs	24%	61%	15%	0%	0%	0%
10 New	Bill of quantity items, drawings & specification inconsistencies	6%	9%	24%	61%	0%	0%
	<u>Other related causes</u>						
1	Disputes with neighboring owners	6%	12%	15%	58%	9%	0%
2	Delay of Statutory undertaker and utility company	0%	15%	12%	70%	3%	0%
3	Changes in statutory requirements	12%	18%	45%	21%	3%	0%
4	Force majeure	6%	18%	9%	61%	6%	0%
5	Restricted access to site and surroundings	15%	9%	15%	55%	6%	0%
6	Inclement weather	58%	12%	27%	3%	0%	0%
7 New	Different physical conditions as planned during the tender stage	39%	33%	24%	3%	0%	0%
8 New	Market Inflation	21%	33%	24%	15%	6%	0%

The selection of the significant level by the experts for each cause was analyzed considering group feedback. Accordingly, the experts' selected significant levels for each cause is divided by the total number of respondents and derived the percentage. The percentage represents the group result of each causes.

In addition to the summary of comments made by the experts in the Delphi round two as shown in Table 4.7, each expert's own responses for each cause marked in bold text for the expert to identify their opinion. It is required for Delphi round three because experts are enabled to make any change if required after seen the group result.

### 4.3.2 Remedies for EOT claims – Owner and Consultant related

Table 4.8 summarizes the answers provided by the experts to the Delphi round two questionnaires.

Table 4.8 – Results, Delphi round 2, Remedies related to Owners and Consultants

	<u>Owner related remedies</u>	Extremely significant	Very significant	Significant	Slightly significant	Not significant	Not applicable
1	Arrange to Provide complete design	36%	55%	9%	0%	0%	0%
2	Introduce new procurement methods (e.g. D&B, Partnering etc.)	15%	21%	6%	48%	9%	0%
3	Proper in detailed site investigations	9%	36%	48%	6%	0%	0%
4	Consider available materials during planning and designing stage	9%	18%	21%	36%	15%	0%
5	Agreement with Contractor on delivery schedules of material and equipment	3%	15%	67%	15%	0%	0%
6	Ensure sufficient finance before start the project	64%	30%	6%	0%	0%	0%
7	Not make major changes	18%	64%	18%	0%	0%	0%
8	Sufficient time for tender preparation	55%	33%	12%	0%	0%	0%
9	Improve communication and coordination	6%	27%	12%	55%	0%	0%
10	Quick decisions to solve problems	3%	33%	64%	0%	0%	0%
11	Check Contractor's resource availability, past performances & capabilities before award lowest bidder	24%	52%	21%	3%	0%	0%
12	Programs make by qualified and experienced personnel	9%	21%	61%	9%	0%	0%
13	Introduce intensive mechanism early completion and enforce LD for delays	12%	21%	9%	58%	0%	0%

	<b><u>Owner related remedies</u></b>	<b>Extremely significant</b>	<b>Very significant</b>	<b>Significant</b>	<b>Slightly significant</b>	<b>Not significant</b>	<b>Not applicable</b>
14	On time payments	33%	45%	21%	0%	0%	0%
15	Speed up approval procedures with allowing sufficient funds	18%	61%	21%	0%	0%	0%
16	Establish realistic project duration	58%	33%	9%	0%	0%	0%
17	Choose experienced consultant	67%	24%	9%	0%	0%	0%
18	Appoint experienced contractors	36%	52%	12%	0%	0%	0%
19 New	Not to change Contractor's sequence of operation only benefitted to owner (method statement)	24%	9%	52%	12%	3%	0%
20 New	Get the Main Contractor's consent prior to appointing other contractors (NSC or Specialist sub-contractor)	21%	15%	61%	3%	0%	0%
21 New	Arrange to obtained approvals for use of foreign labor	9%	15%	15%	61%	0%	0%
22 New	Improve Pre –Contract estimations	9%	18%	70%	3%	0%	0%
	<b><u>Consultant related remedies</u></b>						
1	Speed up finalizing claims	21%	9%	18%	52%	0%	0%
2	Be flexible while evaluating the contractor's Work	18%	9%	24%	48%	0%	0%
3	On-time approval of drawings	61%	30%	9%	0%	0%	0%
4	Do inspection in appropriate time	52%	36%	12%	0%	0%	0%
5	Establish proper mechanism to evaluate variations	82%	15%	3%	0%	0%	0%
6	Speed up resolve disputes	18%	12%	48%	21%	0%	0%
7	Provide comprehensive documents on time	18%	12%	58%	12%	0%	0%
8	Monitor the work closely by timely manner	0%	24%	70%	6%	0%	0%

	<b><u>Owner related remedies</u></b>	<b>Extremely significant</b>	<b>Very significant</b>	<b>Significant</b>	<b>Slightly significant</b>	<b>Not significant</b>	<b>Not applicable</b>
9 New	Analyst actual resources requirement for smooth operation and include to contract	33%	61%	6%	0%	0%	0%
10 New	Closely monitor the construction Program and reminders to the Contractor to catchup any delays	39%	39%	12%	9%	0%	0%

The selection of the significant level by the experts for each remedy was analyzed considering group feedback. Accordingly, the experts' selected significant levels for each remedy are divided by the total number of respondents and derived the percentage. The percentage represents the group result of each remedy.

Besides the summary of the experts' comments in round two of Delphi as presented in Table 4.8, In order to define the expert's opinion, each expert's own response to each remedy was marked in the bold text. For Delphi round three, it is necessary, because experts are enabled to make any change if required after seen the group result.

### 4.3.3 Effects due to EOT claims

Table 4.9 summarizes the answers provided by the experts for the Delphi Round two questionnaire.

Table 4.9 – Results, Delphi round 2, Effects

	<u>Effects of EOT claims</u>	<b>Strongly agreed</b>	<b>Agreed</b>	<b>Neutral</b>	<b>Slightly agreed</b>	<b>Disagreed</b>	<b>Strongly disagreed</b>
1	Abandonment	0%	9%	48%	30%	12%	0%
2	Negative social impact	0%	24%	33%	30%	12%	0%
3	Litigation	0%	18%	79%	3%	0%	0%
4	Idling resources	27%	55%	18%	0%	0%	0%
5	Arbitration	0%	6%	82%	12%	0%	0%
6	Time overrun	52%	24%	21%	3%	0%	0%
7	Cost overrun	39%	33%	24%	3%	0%	0%
8	Disputes	45%	18%	30%	6%	0%	0%

The selection of the significant level by the experts for each effect was analyzed considering group feedback. Accordingly, the experts' selected significant levels for each effect are divided by the total number of respondents and derived the percentage. The percentage represents the group result of each effect.

Besides the summary of the experts' comments in round two of Delphi as presented in Table 4.9, In order to define the expert's opinion, each expert's own response to each effect was marked in the bold text. For Delphi round three, it is necessary, because experts are enabled to make any change if required after seen the group result.

#### **4.4 Delphi Round Three**

In the Delphi round three, the experts have presented the summary response of a group of experts in questionnaire two (Appendix 04) as described in the above chapter 4.3. In this way, their opinions regarding questionnaire two were reconsidered/ revised, and the opinions were confirmed or amended, having reviewed the consensus of the panel of experts. They were asked to keep them as it is which is bold text marked box if they are confirming the same response made for each cause, remedy or effect in questionnaire two and underline another box if they think appropriate to amend their comment after seen at the group's feedback.

In round three, 33 questionnaires were issued to experts and all questionnaires collected on time.

##### **4.4.1 Causes of EOT claims – Owner related**

Table 4.10 derives analysis of the Delphi round three results. Data analysis is done in custom-made Microsoft excel worksheet. Table 4.10 shows individual causes taken Related Importance Index (RII) values in descending order with their ranks. Along with fourteen causes, significant ranks are given from one to fourteen. The first rank received “Unrealistically short project duration (RII 1.67),” and it is the most significant cause. These all fourteen causes are affecting to arise EOT claims and level of their significant are differ with RII values.

Table 4.10 – Results, Delphi round 3, Causes related to Owners

	<b>Owner related Causes of EOT claims</b>	<b>RII</b>	<b>Rank in research</b>
1	Unrealistically short project duration	1.67	1
2	Delay in contractor's payment by the owner	1.63	2
3	Delay of obtaining authority approvals	1.59	3
4	Excessive scope changes or variations	1.47	4
5	Failure to give possession of the site	1.40	5
6	Delay in the supply of materials and goods by the employer	1.39	6
7	Delaying NSC Nomination	1.23	7
8	Inadequate feasibility studies	1.22	8
9	Taking Over of Parts of the Works	1.16	9
10	Awarding to the lowest bidder	1.02	10
11	Errors in setting out information	0.99	11
12	Financial problems of the owner	0.89	12
13	Restricted space for operations & material storage	0.88	13
14	Strict safety procedure and punishments	0.84	14

#### **4.4.2 Causes of EOT claims – Consultant related**

Causes numbers one to ten are analyzed and derives their RII values, and results are shown in Table 4.11 in descending order. The level of significance is indicating their RII values and ranks. The highest RII value of 2.47 taken "Incomplete Contract Document" and it is marked as rank one. That is the most significant consultant related causes for arising EOT claim. Causes numbers from two to ten (ranks two to ten) level of significance will differ from top to bottom. Over 50% expert's marked scale as "Extremely significant" for the causes "Incomplete Contract Document (64%), Delay in approving payments (58%), late instructions (58%), Changes by Consultant (52%)."

Table 4.11 – Results, Delphi round 3, Causes related to Consultants

	Consultant related Causes of EOT claims	RII	Rank
1	Incomplete Contract Document	2.47	1
2	Delay in approving payments	2.02	2
3	Incomplete Tender Document	1.98	3
4	Late instructions	1.97	4
5	Defective designs	1.83	5
6	Bill of quantity items, drawings & specification inconsistencies	1.82	6
7	Changes by Consultant	1.76	7
8	Approvals delay by Consultant (Construction methods, Major changes, tests & inspection)	1.52	8
9	Delay in approving extra work and variations	1.43	9
10	Erroneous cost estimate	0.99	10

#### 4.4.3 Causes of EOT claims – Others related

There are eight other related causes, which are beyond the control of both owner and consultant. Those results compute through Microsoft excel worksheet and a summary presented in Table 4.12 in descending order. Rank one received for “Changes in statutory requirements (RII 1.48)”, and it is the most significant cause in this category. In this category, all causes scale given below 50% by the panel of experts.



Table 4.12 – Results, Delphi round 3, Causes related to Others

	Others related Causes of EOT claims	RII	Rank
1	Changes in statutory requirements	1.48	1
2	Different physical conditions as planned during the tender stage	1.40	2
3	Inclement weather	1.29	3
4	Market Inflation	1.28	4
5	Delay of Statutory undertaker and utility company	1.11	5
6	Disputes with neighbouring owners	1.01	6
7	Restricted access to site and surroundings	1.01	6
8	Force majeure	0.89	7

#### 4.4.4 Causes of EOT claims – Overall ranks of Owners, Consultant and Other related

The answers of all the causes related to owners, consultants and other data analyses together to find the overall significant level and results are presented in Table 4.13 in descending order. Out of 32 causes, the first rank received for “Incomplete Contract Document (RII 2.47)” which is related to Consultant and this is the most significant cause. The second to seventh-ranked causes respectively are “Delay in approving payments (RII 2.02), Incomplete Tender Document (RII 1.98), late instructions (RII 1.98), Defective designs (RII 1.83), Bill of quantity items, drawings & specification inconsistencies (RII 1.82) and Changes by Consultant (RII 1.76) are also related to consultants. Ranks eight to ten received for owner related causes, which are “Unrealistically short project duration (RII 1.67), Delay in contractor’s payment by owner (RII 1.63) and Delay of obtaining authority approvals (RII 1.59)”.

Table 4.13 – Results, Delphi round 3, Causes, overall ranks  
(Owners, Consultants & Others)

	Causes of Owner, Consultant, Others	RII	Rank in Research
1	Incomplete Contract Document	2.47	1
2	Delay in approving payments	2.02	2
3	Incomplete Tender Document	1.98	3
4	Late instructions	1.97	4
5	Defective designs	1.83	5
6	Bill of quantity items, drawings & specification inconsistencies	1.82	6
7	Changes by Consultant	1.76	7
8	Unrealistically short project duration	1.67	8
9	Delay in contractor's payment by the owner	1.63	9
10	Delay of obtaining authority approvals	1.59	10
11	Approvals delay by Consultant (Construction methods, Major changes, tests & inspection)	1.52	11
12	Changes in statutory requirements	1.48	12
13	Excessive scope changes or variations	1.47	13
14	Delay in approving extra work and variations	1.43	14
15	Failure to give possession of the site	1.40	15
16	Different physical conditions as planned during the tender stage	1.40	15
17	Delay in the supply of materials and goods by the employer	1.39	16
18	Inclement weather	1.29	17
19	Market Inflation	1.28	18
20	Delaying NSC Nomination	1.23	19
21	Inadequate feasibility studies	1.22	20
22	Taking Over of Parts of the Works	1.16	21
23	Delay of Statutory undertaker and utility company	1.11	22
24	Awarding to the lowest bidder	1.02	23
25	Disputes with neighboring owners	1.01	24
26	Restricted access to site and surroundings	1.01	24

	Causes of Owner, Consultant, Others	RII	Rank in Research
27	Errors in setting out information	0.99	25
28	Erroneous cost estimate	0.99	25
29	Force majeure	0.89	26
30	Financial problems of the owner	0.89	26
31	Restricted space for operations & material storage	0.88	27
32	Strict safety procedure and punishments	0.84	28

#### 4.4.5 Remedies for EOT claims – Owners related

After analysis owner related remedies for EOT claims, results are presented in Table 4.14 in descending order according to their level of magnitude with considering RII values. Remedies number runs from one to 22 and ranks given one to 19. Rank six has two remedies, and rank 18 also has two remedies. Rank one took the “Choose experienced consultant (RII 2.48)”. Likewise ranking runs from two to 19 and the level of their importance level reducing from top to bottom. “Ensure sufficient finance before start the project (64%)”, “Establish realistic project duration (58%)”, “Sufficient time for tender preparation (55%)” are over 50% scaled as “Extremely significant” by the experts.

Table 4.14 – Results, Delphi round 3, Remedies related to Owners

	Owner related Remedies of EOT claim	RII	Rank
1	Choose experienced consultant	2.48	1
2	Ensure sufficient finance before starting the project	2.40	2
3	Establish realistic project duration	2.13	3
4	Sufficient time for tender preparation	1.98	4
5	Not make major changes	1.88	5
6	Arrange to Provide complete design	1.88	5
7	Speed up approval procedures with allowing sufficient funds	1.77	6

	Owner related Remedies of EOT claim	RII	Rank
8	Appoint experienced contractors	1.77	6
9	Quick decisions to solve problems	1.66	7
10	Improve Pre –Contract estimations	1.63	8
11	On time payments	1.52	9
12	Check Contractor's resource availability, past performances & capabilities before award lowest bidder	1.49	10
13	Agreement with Contractor on delivery schedules of material and equipment	1.48	11
14	Get the Main Contractor's consent prior to appointing other contractors (NSC or Specialist sub-contractor)	1.42	12
15	Programs made by qualified and experienced personnel	1.34	13
16	Proper in detailed site investigations	1.28	14
17	Not to change the Contractor's sequence of operation only benefitted to the owner (method statement)	1.18	15
18	Consider available materials during the planning and designing stage	1.08	16
19	Improve communication and coordination	1.02	17
20	Introduce intensive mechanism early completion and enforce LD for delays	0.94	18
21	Arrange to obtained approvals for the use of foreign labour	0.94	18
22	Introduce new procurement methods (e.g. D&B, Partnering etc.)	0.78	19

#### 4.4.6 Remedies for EOT claims – Consultant related

The received data computed and prepare the results in descending order according to the RII values and rank them and shown in Table 4.15. Out of 10 remedies, the first rank took “On-time approval of drawings (RII 4.15). Similarly, 91% of experts marked it as “Extremely significant.” From the rest of the nine remedies, significant level higher remedies are starting from the top and likewise lowering significant levels when moved to the bottom.

Table 4.15 – Results, Delphi round 3, Remedies related to Consultants

	Consultant related Remedies of EOT claim	RII	Rank
1	On-time approval of drawings	4.15	1
2	Establish proper mechanism to evaluate variations	3.44	2
3	Provide comprehensive documents on time	2.67	3
4	Analyst actual resources requirement for smooth operation and include to contract	2.04	4
5	Do inspection in appropriate time	1.90	5
6	Monitor the work closely by the timely manner	1.70	6
7	Closely monitor the construction Program and reminders to the Contractor to catch-up any delays	1.46	7
8	Speed up resolve disputes	1.02	8
9	Speed up finalizing claims	0.89	9
10	Be flexible while evaluating the contractor's Work	0.84	10

#### 4.4.7 Remedies for EOT claims - Overall rank of Owners and Consultant related

Finally, all owner and consultant related remedies put together and analyzed them to receive an overall significance level. Results are presented in Table 4.16 in descending order. Accordingly, out of 32 remedies the rank one received for “On-time approval of drawings (RII 4.15)”, which is a consultant related remedy. Correspondingly two and three ranks respectively received for “Establish a proper mechanism to evaluate variations (RII 3.44)” and “provide comprehensive documents on time (RII 2.67)” which are also consultant related. The fourth rank received for owner related remedies such as “Choose experienced consultant (RII 2.48)”.

Table 4.16 – Results, Delphi round 3, Remedies, overall ranks  
(Owners & Consultants)

	<b>Owner &amp; Consultant related Remedies of EOT claim</b>	<b>RII</b>	<b>Rank in Research</b>
1	On-time approval of drawings	4.15	1
2	Establish proper mechanism to evaluate variations	3.44	2
3	Provide comprehensive documents on time	2.67	3
4	Choose experienced consultant	2.48	4
5	Ensure sufficient finance before starting the project	2.40	5
6	Establish realistic project duration	2.13	6
7	Analyst actual resources requirement for smooth operation and include to contract	2.04	7
8	Sufficient time for tender preparation	1.98	8
9	Do inspection in appropriate time	1.90	9
10	Not make major changes	1.88	10
11	Arrange to Provide complete design	1.88	10
12	Speed up approval procedures with allowing sufficient funds	1.77	11
13	Appoint experienced contractors	1.77	11
14	Monitor the work closely by the timely manner	1.70	12
15	Quick decisions to solve problems	1.66	13
16	Improve Pre –Contract estimations	1.63	14
17	On time payments	1.52	15
18	Check Contractor's resource availability, past performances & capabilities before award lowest bidder	1.49	16
19	Agreement with Contractor on delivery schedules of material and equipment	1.48	17
20	Closely monitor the construction Program and reminders to the Contractor to catch up any delays	1.46	18
21	Get the Main Contractor's consent prior to appointing other contractors (NSC or Specialist sub-contractor)	1.42	19
22	Programs make by qualified and experienced personnel	1.34	20
23	Proper in detailed site investigations	1.28	21
24	Not to change the Contractor's sequence of operation only benefitted to the owner (method statement)	1.18	22

	<b>Owner &amp; Consultant related Remedies of EOT claim</b>	<b>RII</b>	<b>Rank in Research</b>
25	Consider available materials during the planning and designing stage	1.08	23
26	Speed up resolve disputes	1.02	24
27	Improve communication and coordination	1.02	24
28	Introduce intensive mechanism early completion and enforce LD for delays	0.94	25
29	Arrange to obtained approvals for the use of foreign labor	0.94	25
30	Speed up finalizing claims	0.89	26
31	Be flexible while evaluating the contractor's Work	0.84	27
32	Introduce new procurement methods (e.g. D&B, Partnering etc.)	0.78	28

#### 4.4.8 Effects due to EOT claims

Effects of EOT claims are analyzed by the custom made Microsoft excel worksheet and results are made to descending order according to their RII values and results are presented in Table 4.17 with giving applicable ranks. Out of eight effects, the first rank took “Time overrun (RII 3.89)”. The second rank was “Cost overrun (RII 3.21)”. Likewise, according to the level of significant ranks run from top to bottom start from three to eight are also presented in Table 4.17.

Table 4.17 – Results, Delphi round 3, Effects

	<b>Effects of EOT claim</b>	<b>RII</b>	<b>Rank</b>
1	Time overrun	3.89	1
2	Cost overrun	3.21	2
3	Disputes	2.23	3
4	Idling resources	2.16	4
5	Arbitration	2.05	5
6	Litigation	2.00	6
7	Abandonment	0.94	7
8	Negative social impact	0.77	8

#### 4.5 Discussion of results

Compared to Delphi round two results, final Delphi results and previous research findings, the outcome of the discussions is performed.

##### 4.5.1 Causes of EOT claims – Owner related

The summary of Delphi results round two and three, as illustrated in Table 4.18. Comparing owner-related causes in round two with round three in round two, the round three first rank of “Unrealistically short project duration” was rank two. In round three, second place was ranked one in round two for the “Delay in contractors' payments by owner.” Round three and round two are equal to the “Delay in obtaining authority approvals.”

The “Delay of obtaining authority approvals” is identical to that of round three and round two (rank three). In round two rank one taken for two causes in that second cause was “Delay in the supply of materials and goods by the employer,” but that was rank six in round three.

Table 4.18 – Results comparison- Delphi R2 & R3 – Causes, related to Owners

	Owner related Causes of EOT claims	Delphi Round 2		Delphi Round 3	
		RII	Rank in research	RII	Rank in research
1	Unrealistically short project duration	1.57	2	1.67	1
2	Delay in contractor’s payment by owner	1.63	1	1.63	2
3	Delay of obtaining authority approvals	1.50	3	1.59	3
4	Excessive scope changes or variations	1.24	6	1.47	4
5	Failure to give possession of the site	1.40	4	1.40	5
6	Delay in the supply of materials and goods by the employer	1.63	1	1.39	6
7	Delaying NSC Nomination	1.26	5	1.23	7
8	Inadequate feasibility studies	1.22	7	1.22	8



		Delphi Round 2		Delphi Round 3	
	Owner related Causes of EOT claims	RII	Rank in research	RII	Rank in research
9	Taking Over of Parts of the Works	1.16	8	1.16	9
10	Awarding to lowest bidder	0.87	11	1.02	10
11	Errors in setting out information	0.83	13	0.99	11
12	Financial problems of the owner	0.89	9	0.89	12
13	Restricted space for operations & material storage	0.88	10	0.88	13
14	Strict safety procedure and punishments	0.84	12	0.84	14

The following are comparisons to previous research of the top five ranks taken from this research.

The rank one has taken “Unrealistically short project duration” is within the top five ranks in the researches of; Durdyev, Omarov and Ismail, 2017 in Cambodia, Lessing, Thurnellb and Durdyevb, 2017 in New Zealand and Mpofu, Ochieng, Moobela and Pretorius, 2017 in the United Arab Emirates (UAE).

The rank two of “Delay in contractor’s payment by owner” is also within the top five ranks in the researches of; Niazi and Painting (2017) in Afghanistan, Marzouk and El-Rasas (2014) in Egypt and Pourrostan and Ismail (2012) in Iran.

Compare to rank three in Delphi round three taken cause of “Delay of obtaining authority approvals” is within the top five ranks in the researches of Maduranga, Palamakumbura and Dissanayake, 2016 in Sri Lanka.

In the round three rank four taken “Excessive scope changes or variations” is within top five ranks of in the researches of; Niazi and Painting (2017) in Afghanistan, Al-Hazim, Salem and Ahmad, 2017 in Jordan, Lessing et al. (2017) in New Zealand, Mpofu et al. (2017) in UAE, Marzouk and El-Rasas (2014) in Egypt, Pourrostan and Ismail (2012) in Iran, Maduranga et al. (2016) in Sri Lanka.

However, rank five taken “Failure to give possession of site” in round three is within the top ten ranks in the previous research of Mpofu et al. (2017) in UAE.

#### 4.5.2 Causes of EOT claims – Consultant related

The results of Delphi in round three and round two are shown in Table 4.19. The "Incomplete Contract Document" is, therefore, the same ranked one in the three and two rounds. In round three rank two, "Delay in approving payments" in round two was in the fourth place. The “Incomplete Tender Document” is rank three in round three but rank seven in round two.

Table 4.19 – Results comparison- Delphi R2 & R3 – Causes, related to Consultants

	Consultant related Causes of EOT claims	Delphi Round 2		Delphi Round 3	
		RII	Rank in research	RII	Rank in research
1	Incomplete Contract Document	2.47	1	2.47	1
2	Delay in approving payments	1.76	4	2.02	2
3	Incomplete Tender Document	1.27	7	1.98	3
4	Late instructions	1.97	2	1.97	4
5	Defective designs	1.83	3	1.83	5
6	Bill of quantity items, drawings & specification inconsistencies	0.96	9	1.82	6
7	Changes by Consultant	0.88	10	1.76	7
8	Approvals delay by Consultant (Construction methods, Major changes, tests & inspection)	1.52	5	1.52	8
9	Delay in approving extra work and variations	1.43	6	1.43	9
10	Erroneous cost estimate	0.97	8	0.99	10

Comparing Delphi round three top-five ranks with previous research in different places, it was observed that rank positioning for consultant-related causes is as follows.

The rank one took “Incomplete Contract Document” is compared to researches of; Mpofu et al. (2017) in UAE, Alloh (2014) in Palestine, Mydin, Sani, Taib and Alias, 2014 in Malaysia also within the top five ranks.

The rank two of “Delay in approving payments” also within the top ten ranks in the research of Mpofu et al. (2017) in UAE.

The cause of “Incomplete Tender Document” is rank three in round three and it is compared to previous researches of; Mpofu et al. (2017) in UAE, Mydin et al. (2014) in Malaysia are within the top five causes.

The rank four of “Late instructions” with compare to previous researches of; Lessing et al. (2017) in New Zealand, Mpofu et al. (2017) in UAE is also within the top five ranks.

Rank five taken the cause of “Defective designs” when comparing to previous researches it is within the top five ranks such as; Howze and Dalrymple (2004) in Jordan, Lessing et al. (2017) in New Zealand, Mpofu et al. (2017) in UAE, Alloh (2014) in Palestine.

#### **4.5.3 Causes of EOT claims – Other related**

Delphi rounds two and three comparisons of results for other related causes are summarized in Table 4.20. In sequence final round rank one “Changes in statutory requirements” is in round two was rank four. Rank one of “Inclement weather” in round two become rank three in round three.

The cause of “Different physical conditions as planned during the tender stage” is the equal rank in round two and round three. The “Market Inflation” is the rank four taken cause in round three results, and however, in round two, it was rank six. The rank five of round three “Delay of Statutory undertaker and utility company” was rank three in round two results.

Table 4.20 – Results comparison- Delphi R2 & R3 – Causes, related to Others

	Other related Causes of EOT claims	Delphi Round 2		Delphi Round 3	
		RII	Rank in research	RII	Rank in research
1	Changes in statutory requirements	0.92	4	1.48	1
2	Different physical conditions as planned during the tender stage	1.40	2	1.40	2
3	Inclement weather	1.94	1	1.29	3
4	Market Inflation	0.90	6	1.28	4
5	Delay of Statutory undertaker and utility company	1.11	3	1.11	5
6	Disputes with neighbouring owners	0.82	7	1.01	6
7	Restricted access to site and surroundings	0.82	7	1.01	6
8	Force majeure	0.91	5	0.89	7

The following are the top five ranks compared to previous research.

Compared to previous research, it has been shown that final results concluded, rank one is "Changes in statutory requirements" is not in either top five ranks or top ten ranks. Therefore "Changes in statutory requirements" is more important in view of the Sri Lankan context.

Rank two taken for the “Different physical conditions as planned during the tender stage” and it is compared to previous researches from; Lessing et al. (2017) in New

Zealand, Mydin et al. (2014) in Malaysia, Maduranga et al. (2016) in Sri Lanka, it is discovered that within the top five ranks.

The rank three “Inclement weather” compare to previous researches such as; Mydin et al. (2014) in Malaysia, Al-Hazim et al. (2017) in Jordan, Lessing et al. (2017) in New Zealand, Maduranga et al. (2016) in Sri Lanka also within the top five ranks in their researches.

In this research rank four taken cause of “Market Inflation” within the top ten ranks according to the previous researches of; Niazi and Painting (2017) in Afghanistan, Al-Hazim et al. (2017) in Jordan.

In this research ranking, five were also considered “Delay of Statutory undertaker and Utility Company” within the top ten ranks according to the previous researches of; Niazi and Painting (2017) in Afghanistan, Mpofu et al. (2017) in UAE.

#### **4.5.4 Overall comparison owner, consultant and other related causes of EOT claims**

The purpose is to identify the most important causes for the owners, consultants, and others in comparison with Delphi in the third and second round. The results are summarized in Table 4.21. Accordingly, rank one took "Incomplete Contract Document" is equal in round three and round two ranks.

In round two, round three ranks two of "Delay in approving payments" was rank five. Rank three in round three of "Incomplete Tender Document" was rank twelve in round two. Rank two in round two was the fourth rank taken "Late Instructions" in round three. The "Defective Designs" in round three were in five, compared with round two, in the fourth position. The specialty is all the top five rankings in which the consultant is involved.

Table 4.21 – Results comparison- Delphi R2 & R3 – Causes, Overall ranks  
(owners, consultant & others)

Party		Causes of Owner, Consultant, Other	Delphi Round 2		Delphi Round 3	
			RII	Rank in research	RII	Rank in research
Consultant	1	Incomplete Contract Document	2.47	1	2.47	1
Consultant	2	Delay in approving payments	1.76	5	2.02	2
Consultant	3	Incomplete Tender Document	1.27	12	1.98	3
Consultant	4	Late instructions	1.97	2	1.97	4
Consultant	5	Defective designs	1.83	4	1.83	5
Consultant	6	Bill of quantity items, drawings & specification inconsistencies	0.96	19	1.82	6
Consultant	7	Changes by Consultant	0.88	24	1.76	7
Owner	8	Unrealistically short project duration	1.57	7	1.67	8
Owner	9	Delay in contractor's payment by owner	1.63	6	1.63	9
Owner	10	Delay of obtaining authority approvals	1.50	9	1.59	10
Consultant	11	Approvals delay by Consultant (Construction methods, Major changes, tests & inspection)	1.52	8	1.52	11
Other	12	Changes in statutory requirements	0.92	20	1.48	12
Owner	13	Excessive scope changes or variations	1.24	14	1.47	13
Consultant	14	Delay in approving extra work and variations	1.43	10	1.43	14
Owner	15	Failure to give possession of site	1.40	11	1.40	15
Other	16	Different physical conditions as planned during the tender stage	1.40	11	1.40	15
Owner	17	Delay in the supply of materials and goods by the employer	1.63	6	1.39	16
Other	18	Inclement weather	1.94	3	1.29	17
Other	19	Market Inflation	0.90	22	1.28	18
Owner	20	Delaying NSC Nomination	1.26	13	1.23	19
Owner	21	Inadequate feasibility studies	1.22	15	1.22	20
Owner	22	Taking Over of Parts of the Works	1.16	16	1.16	21

			Delphi Round 2		Delphi Round 3	
Party		Causes of Owner, Consultant, Other	RII	Rank in research	RII	Rank in research
Other	23	Delay of Statutory undertaker and utility company	1.11	17	1.11	22
Owner	24	Awarding to lowest bidder	0.87	25	1.02	23
Other	25	Disputes with neighboring owners	0.82	28	1.01	24
Other	26	Restricted access to site and surroundings	0.82	28	1.01	24
Owner	27	Errors in setting out information	0.83	27	0.99	25
Consultant	28	Erroneous cost estimate	0.97	18	0.99	25
Other	29	Force majeure	0.91	21	0.89	26
Owner	30	Financial problems of the owner	0.89	23	0.89	26
Owner	31	Restricted space for operations & material storage	0.88	24	0.88	27
Owner	32	Strict safety procedure and punishments	0.84	26	0.84	28

#### 4.5.5 Remedies for EOT claims – Owner related

Comparison of owner related remedies of EOT claims in Delphi round two and three, the summary presented in Table 4.22. In sequence rank, one to fifteen is taken equal ranks in both rounds two and three.

Table 4.22 – Results comparison- Delphi R2 & R3 - Remedies related to Owners

		Delphi Round 2		Delphi Round 3	
	Owner related Remedies of EOT claim	RII	Rank in research	RII	Rank in research
1	Choose experienced consultant	2.48	1	2.48	1
2	Ensure sufficient finance before starting the project	2.40	2	2.40	2
3	Establish realistic project duration	2.13	3	2.13	3
4	Sufficient time for tender preparation	1.98	4	1.98	4

		Delphi Round 2		Delphi Round 3	
	Owner related Remedies of EOT claim	RII	Rank in research	RII	Rank in research
5	Not make major changes	1.88	5	1.88	5
6	Arrange to Provide complete design	1.88	5	1.88	5
7	Speed up approval procedures with allowing sufficient funds	1.77	6	1.77	6
8	Appoint experienced contractors	1.77	6	1.77	6
9	Quick decisions to solve problems	1.66	7	1.66	7
10	Improve Pre –Contract estimations	1.63	8	1.63	8
11	On time payments	1.52	9	1.52	9
12	Check Contractor's resource availability, past performances & capabilities before award lowest bidder	1.49	10	1.49	10
13	Agreement with Contractor on delivery schedules of material and equipment	1.48	11	1.48	11
14	Get the Main Contractor's consent prior to appointing other contractors (NSC or Specialist sub-contractor)	1.42	12	1.42	12
15	Programs made by qualified and experienced personnel	1.34	13	1.34	13
16	Proper in detailed site investigations	1.28	14	1.28	14
17	Not to change the Contractor's sequence of operation only benefitted to the owner (method statement)	1.23	15	1.18	15
18	Consider available materials during the planning and designing stage	0.60	19	1.08	16
19	Improve communication and coordination	0.96	16	1.02	17
20	Introduce intensive mechanism early completion and enforce LD for delays	0.94	17	0.94	18
21	Arrange to obtained approvals for the use of foreign labor	0.94	17	0.94	18
22	Introduce new procurement methods (e.g. D&B, Partnering etc.)	0.78	18	0.78	19



The conclusions of this research show that the top five owners related remedies are as follows; “Choose experienced consultant,” “Ensure sufficient finance before start the project,” “Establish realistic project duration,” “Sufficient time for tender preparation,” “Not make major changes.”

Refer to several previous research findings, it is observed that no ranks are found in any of them. They found the list of remedies but no ranks according to their significant levels.

#### **4.5.6 Remedies for EOT claims – Consultant related**

Table 4.23 shows a summary of the Delphi round three-and-two results for consultant-related remedies to avoid EOT claim. In that rank, one of "On-time approval of drawings" is rank two in round two. In the round, two rank one taken "Establish a proper mechanism to evaluate variations" was rank two in round three.

"Providing comprehensive documents on time" ranks three in round three, but ranks seven in round two. In round three ranks four taken remedy "Analyst actual resources requirement for smooth operation and include to contract" is comparing to round two it was rank three. Likewise, when compared to rank five in round three with round two, it was ranked four in round two, i.e., "Do inspections in an appropriate time."

Table 4.23 – Results comparison- Delphi R2 & R3 - Remedies related to Consultant

	Consultant related Remedies of EOT claim	Delphi Round 2		Delphi Round 3	
		RII	Rank in research	RII	Rank in research
1	On-time approval of drawings	2.23	2	4.15	1
2	Establish proper mechanism to evaluate variations	3.44	1	3.44	2
3	Provide comprehensive documents on time	1.25	7	2.67	3
4	Analyst actual resources requirement for smooth operation and include to contract	2.04	3	2.04	4
5	Do inspection in appropriate time	1.90	4	1.90	5
6	Monitor the work closely by the timely manner	1.70	5	1.70	6
7	Closely monitor the construction Program and reminders to the Contractor to catch up any delays	1.46	6	1.46	7
8	Speed up resolve disputes	1.02	8	1.02	8
9	Speed up finalizing claims	0.89	9	0.89	9
10	Be flexible while evaluating the contractor's Work	0.84	10	0.84	10

Also, it was found that they have not found ranks for the remedies consider previous researches in different places. Most authors have recommended a list of remedies to be applied to mitigate the resulting EOT claim but do not include priority.

#### 4.5.7 Overall Comparison of the owner and consultant related remedies

To find out the most significant remedies from the related parties of owner and consultant, remedies are compared all together with Delphi round three and two results. The summary of the results is described in Table 4.24. Accordingly, consultant related remedy of “On-time approval of drawings” is rank one in round three, round two rank four.

In round two ranked one, a consultant related remedy of “Establishing a proper mechanism for evaluating variations” is in round three rank two. Rank three in round three compare to round two it was rank 21, that is also consultant related remedy of “Provide comprehensive documents on time.” In the round three ranks, four and five are related to an owner such as; “Choose experienced consultant” and “Ensure sufficient finance before start the project” respectively. When these two remedies compare to round two, the ranks are taken as two and three.

The important point is in the final round taken ranks one, two and three all are related to the consultant.

Table 4.24 – Results comparison- Delphi R2 & R3 – Remedies, Overall ranks  
(owners & consultants)

Party		Owner & Consultant related Remedies of EOT claim	Delphi Round 2		Delphi Round 3	
			RII	Rank in research	RII	Rank in research
Consultant	1	On-time approval of drawings	2.23	4	4.15	1
Consultant	2	Establish proper mechanism to evaluate variations	3.44	1	3.44	2
Consultant	3	Provide comprehensive documents on time	1.25	21	2.67	3
Owner	4	Choose experienced consultant	2.48	2	2.48	4
Owner	5	Ensure sufficient finance before starting the project	2.40	3	2.40	5
Owner	6	Establish realistic project duration	2.13	5	2.13	6
Consultant	7	Analyst actual resources requirement for smooth operation and include to contract	2.04	6	2.04	7
Owner	8	Sufficient time for tender preparation	1.98	7	1.98	8
Consultant	9	Do inspection in appropriate time	1.90	8	1.90	9
Owner	10	Not make major changes	1.88	9	1.88	10
Owner	11	Arrange to Provide complete design	1.88	9	1.88	10
Owner	12	Speed up approval procedures with allowing sufficient funds	1.77	10	1.77	11
Owner	13	Appoint experienced contractors	1.77	10	1.77	11

			Delphi Round 2		Delphi Round 3	
Party		Owner & Consultant related Remedies of EOT claim	RII	Rank in research	RII	Rank in research
Consultant	14	Monitor the work closely by the timely manner	1.70	11	1.70	12
Owner	15	Quick decisions to solve problems	1.66	12	1.66	13
Owner	16	Improve Pre –Contract estimations	1.63	13	1.63	14
Owner	17	On time payments	1.52	14	1.52	15
Owner	18	Check Contractor's resource availability, past performances & capabilities before award lowest bidder	1.49	15	1.49	16
Owner	19	Agreement with Contractor on delivery schedules of material and equipment	1.48	16	1.48	17
Consultant	20	Closely monitor the construction Program and reminders to the Contractor to catch up any delays	1.46	17	1.46	18
Owner	21	Get the Main Contractor's consent prior to appointing other contractors (NSC or Specialist sub-contractor)	1.42	18	1.42	19
Owner	22	Programs make by qualified and experienced personnel	1.34	19	1.34	20
Owner	23	Proper in detailed site investigations	1.28	20	1.28	21
Owner	24	Not to change the Contractor's sequence of operation only benefitted to the owner (method statement)	1.23	22	1.18	22
Owner	25	Consider available materials during the planning and designing stage	0.60	29	1.08	23
Consultant	26	Speed up resolve disputes	1.02	23	1.02	24
Owner	27	Improve communication and coordination	0.96	24	1.02	24
Owner	28	Introduce intensive mechanism early completion and enforce LD for delays	0.94	25	0.94	25
Owner	29	Arrange to obtained approvals for use of foreign labor	0.94	25	0.94	25
Consultant	30	Speed up finalizing claims	0.89	26	0.89	26
Consultant	31	Be flexible while evaluating the contractor's Work	0.84	27	0.84	27
Owner	32	Introduce new procurement methods (e.g. D&B, Partnering etc.)	0.78	28	0.78	28

#### 4.5.8 Effect of EOT claim

Table 4.25 illustrated the Delphi round two comparison summaries with round three. Accordingly, it can be identified that in round three, rank one took "time overrun" was rank three in round two. In round two rank one took "Arbitration" in round three was rank five. The "Cost overrun" is ranked two in round three and ranked six in round two. The "Dispute" is ranked three in round three, but rank five in round two. However, rank four of "Idling Resources" is equal in both round three and round two.

Table 4.25 – Results comparison- Delphi R1 & R2 - Effect

	Effects of EOT claim	Delphi Round 2		Delphi Round 3	
		RII	Rank in research	RII	Rank in research
1	Time overrun	1.70	3	3.89	1
2	Cost overrun	1.40	6	3.21	2
3	Disputes	1.45	5	2.23	3
4	Idling resources	1.66	4	2.16	4
5	Arbitration	2.05	1	2.05	5
6	Litigation	2.00	2	2.00	6
7	Abandonment	0.94	7	0.94	7
8	Negative social impact	0.77	8	0.77	8

Accordingly, the top five ranks compare with previous research and the results are as follows.

When compared to rank one "Time overrun" it was found that this effect is within their top five ranks of effects, such as; Pourrostam and Ismail (2012) in Cambodia, Sambasivan and Soon (2007) in Malaysia and also with Mydin et al. (2014) in Malaysia.

The rank two of this research is “Cost overrun” and it is compared to previous researches of; Pourrostam and Ismail (2012) in Cambodia, Sambasivan and Soon (2007), Mydin et al. (2014) in Malaysia, it was found that within the top five ranks.

The “Disputes” is the rank-three effect of this research and it is compared to the following research that these effects have been found within top five ranks in their research, such as; Pourrostam and Ismail (2012) in Cambodia, Sambasivan and Soon (2007), Mydin et al. (2014) in Malaysia.

However, when compared to several previous research, it was found that it was not in the top five or even top ten ranks in this research rank four taken for “Idling Resources.” It is, therefore, a special situation for the building projects in Sri Lanka.

Rank five of this research is “Arbitration,” and it is also within the top five ranks of the following researches; Pourrostam and Ismail (2012) in Cambodia, Sambasivan and Soon (2007) in Malaysia.

## **CHAPTER 5: Conclusions & Recommendations**

### **5.1 Introduction**

This chapter provides the conclusions of how the research findings are directed toward successfully managing an EOT claim. Under the section of recommendations provide the individual recommendations to owners, consultants, and project management system developers to apply preventive mechanisms in order to successfully manage the EOT claims in building construction projects in Sri Lanka. The further study provides, which are identified in the course of research as the most relevant areas to be researched by future researchers.

A summary of adhering process for achieving study target is; reviewing previously published researches discovered EOT claim is the most dominant types of claims, common causes of EOT claims with party wise analysis, available remedies with party wise and arising effects due to EOT claims. Likewise, the literature review followed a total of 86 previous researches. Accordingly, formulated research questionnaire was tested via the pilot survey and conducted the survey research by three rounds of Delphi technique. In the process of verifying applicable causes, remedies, and effects, it was found to exist several new factors relevant to the Sri Lanka building construction projects. The research also recognized the most significant causes of EOT claims in party wise, most applicable remedies with applicable parties and most significant effects. Final results are validated through the expert validation process and based on that recommendations were developed.

### **5.2 Conclusions**

There are various types of claims observed in the construction industry and in that most arising type of claim found as EOT claims. The EOT claims are arising mainly due to the causes, the attitude of contracting parties, and the ever-increasing complexity of the projects. It is more cost effective to manage EOT claims than resolving them through ADR method or litigation.

The current research discovered the level of significance in 14 owner related causes of EOT claims, followed that most significant owner related cause was found as “Unrealistically short project duration.” Consultant related ten causes were found with significant level and in that most significant cause was found as “Incomplete Contract Document.” Related to other category found eight causes with significant level and among them, the most significant cause was found as “Changes in statutory requirements.” Comparing all together causes related to the owner, consultant and others provided the significant level and in that the most significant cause was found as “Incomplete Contract Document” which is related to a consultant.

There are 22 owner related remedies of EOT claim found as applicable to Sri Lanka with the level of significance. Accordingly, “Choose experienced consultant” was found as the most significant remedy. Consultant related ten remedies were found with significant level and in that “On-time approval of drawings” was found as the most significant remedy. Overall significant level was found in comparing both together and the most significant remedy was as “On-time approval of drawings,” which is related to a consultant. Consequently, it was found that in overall comparison, the ranks one, two, and three are related to consultants.

As applicable effects to Sri Lanka found eight effects with its significant level and found the most arising effect as “Time overrun.”

Interestingly, a significant level of causes, remedies, and effects of EOT claims found in Sri Lanka were mostly differed comparing to the previous researches. Finding of significant ranks for remedies, overall ranks for causes and remedies are new to the industry. In conclusion, this study provides a significant contribution to the relevant professionals in the industry.



### **5.3 Recommendations**

Since the number of EOT claims are significantly increasing day by day in Sri Lanka, it is evident that there is no proper management mechanism to manage them to avoid or minimizing claims. Therefore addressing most significant causes while knowing the significant level and applying most applicable remedy with knowing its significant level and keeping the knowledge of the significant level of effects are vital to managing the EOT claims. The recommendations are provided mainly for three parties individually, such as owners, consultants, and project management system developers.

#### **5.3.1 Recommendations to Owners**

Owners are recommended to give first priority to address the owner related causes by considering given significant level. Addressing all causes simultaneously is impractical. Similarly, without giving priority by considering their significant level addressing causes may not be practical because that cause may not have much influence to arise EOT claims.

Second priority to be given to the owner related remedies. Application to be made by considering their values of significant level. Otherwise, blindly applying remedies without knowing the significant level of each remedy may not a success for managing EOT claims. Simultaneous applications of all remedies are also not practicable.

Third priority to be given other related causes. Considering the provided significant level owners are enabling to develop a precautionary strategy to overcome the situation.

Above said all three steps effects of EOT claims to be taken into account because if the effect is known, then it provides influence to owners for address causes or applies remedies. Given significant levels indicate the frequency of each effect and that provides owners to understand their effects in a more knowledgeable manner.

### **5.3.2 Recommendations to Consultants**

The consultants are recommended to give first priority for consultant related causes with considering provided significant levels. It is vital to factor that addressing priority-wise for the causes since it is impractical to address all at ones. Addressing by not considering significant level may not provide the desired objective because addressing less significant causes may not provide much influence to avoid EOT claim. As provided by the owners, consultants, and other related causes the most significant rank taken for consultant related cause. In effect, owners have a considerable role to play in managing EOT claims.

The consultants also need to give second priority for applying provided remedies with considering their significant level. In the remedies most significant level taken (rank one, rank two and rank three) for related remedies to a consultant from an overall comparison of the owner and consultant related remedies. The impact is consultants have a much stronger role to play in managing EOT claims.

Accordingly, for the other related causes to give third priority by understanding their significant level. Even though it is beyond the control of consultants, they can develop a strategy by considering the significant level and incorporate into a contract to minimize impact to arising an EOT claim.

Consultants are strongly recommended to consider provided effects with the level of significance in the stages of preparation, design, pre-construction, and construction.

### **5.3.3 Recommendations to Project Management (PM) Developers**

It is recommended to PM developers to use the above recommended owner related causes, consultant related causes, other related causes, owner related remedies, consultant related remedies and effects of EOT claims by considering provided significant level. According to the provided significant level, it enables developers to decide the weight of the strategies.

#### **5.3.4 Further study**

Separate research is recommended to carry out for an individual team of consultants such as Design consultant, Engineers to contract, Project Management consultant, Cost Consultant with the subject area of causes, remedies, and effects of EOT claims in order to find out the most responsible team among consultant.

Separate research is also recommended for Investigating Causes of Contractors own delays, possible remedies to avoid Liquidated damages (LD), and effects other than LD.

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